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Cotton Variety Tests in the Yazoo-Mississippi Delta

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By

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Cotton Variety Tests in the Yazoo-Mississippi Delta

By J. WINSTON NEELY and SIDNEY G. BRAIN
Delta Branch Experiment Station, Stoneville

The 1944 cotton variety tests in the Yazoo-Mississippi Delta are a continuation of the practice by the Delta Branch Experiment Station to test varieties on selected plantations in the representative sections of the Delta.

In the tests being reported, 12 varieties were grown at 7 locations: Stoneville, Tunica, Money, Heathman, Valley Hill, Yazoo City, and Kelso. Yields of seed cotton and lint, gin turn-out, staple length, boll size, the fiber bundle strength and length uniformity of fiber, earliness, and money value were determined.

The Station is continuing the policy of adapting the cotton variety tests to the current needs of producers, buyers, spinners, weavers, and oil mill operators for information relative to the characteristics of varieties. During the time that the boll weevil was first becoming a production factor, information was provided regarding the relative boll weevil tolerance of cotton varieties because of earliness. When pathogenic wilt became a production factor in certain areas of the Delta, information was provided regarding the relative wilt resistance of the different varieties.

At the present time cotton mills are paying a great deal of attention to bundle strength and length uniformity, as measured by laboratory methods, since these characteristics, along with length, give an indication of the resulting yarn strength. The current report is the second from this Station in which fiber strength and length uniformity for each of the varieties grown at each of the locations have been reported. This policy will be continued, and as additional information relative to the characteristics of cotton varieties is required, the tests will be extended to supply as much of this information as possible.

The yields of each variety are based upon the weights of seed cotton harvested from ten 1-row plots at each location.

Gin turn-out values for each variety were determined by ginning the 100-boll samples from each location on a 10-saw gin.

Staple lengths given are averages of lengths of 10 samples for each variety from each location, determined by the Staple Cotton Cooperative Association, Greenwood, Mississippi, and the Board of Cotton Examiners of the War Food Administration, Jackson. Mississippi.

The size of boll was determined by averaging the weights of ten 100-boll samples from each variety at each of the locations.

The percentage of cotton obtained from the first picking, which is considered as a measure of earliness, was determined by dividing the first picking by the weight of the total production.

The bundle strength of fiber and the fiber length uniformity were determined in the Stoneville Fiber Laboratory of the War Food Administration.

The acre values are based upon: (1) Yields of seed cotton and lint, (2) staple lengths, and (3) seed grades. The values for three grades—Middling, Strict Low Middling, and Low Middling—are given. The average prices for cotton of the respective grades and several lengths for the active Memphis spot market period, September 9 to November 10, 1944, were used. The seed were evaluated on a basis of $56, with premiums and discounts in accordance with official standards for grading cottonseed set up by the U. S. Department of Agriculture. The analyses were made in the Stoneville Laboratory of the War Food Administration.

Oil, protein, moisture, and lint determinations were based upon two analyses of

Table 1. Stoneville cotton variety test, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	Inches	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols.
Bobdel	2284	738	32.3	1-3/32	72.5	67.8	87,900	78.8	226	211	186
Bobshaw 1	2450	848	34.6	1-1/16	68.8	60.3	87,100	80.8	247	232	205
Coker 100-8	2367	871	36.8	1-3/32	70.8	58.3	83,300	76.0	248	232	203
Delfos 444	2337	692	29.6	1-1/8	83.4	65.0	79,600	80.6	230	211	181
Delfos 531C	2280	741	32.5	1-1/8	79.1	63.3	80,800	75.0	242	222	190
Delfos 651	2224	741	33.3	1-3/32	78.2	57.5	82,300	75.3	232	214	186
Deltapine 14	2352	962	40.9	1-1/16	73.8	49.6	78,200	81.8	264	248	218
Miller	2393	873	36.5	31/32	62.3	63.2	82,500	83.2	234	223	202
Rowden (Roldo)	2459	880	35.8	1	54.8	56.7	83,300	84.0	239	228	205
Stoneville 2B	2613	912	34.9	1-3/32	63.7	54.2	84,000	77.8	273	254	222
Stoneville 2C	2560	858	33.5	1-3/32	65.9	57.6	84,300	76.8	266	246	213
Wilds 16	2053	671	32.7	1-1/4	74.1	55.3	92,400	73.9	249	224	172
Dif. barely significant	189	66	.6	1/32	1.9	4.0	2,400	2.5	22	20	16
Dif. highly significant	250	87	.8	1/32	2.5	5.3	3,200	3.3	29	26	22

Table 2. Tunica cotton variety test, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	Inches	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols.
Bobdel	1684	522	31.0	1-1/8	70.2	49.6	80,200	82.6	175	160	137
Bobshaw 1	1845	613	33.2	1-3/32	65.4	38.4	78,800	79.1	188	175	153
Coker 100-8	1764	624	35.4	1-1/8	68.7	46.0	76,000	77.8	194	178	151
Delfos 444	1809	494	27.3	1-5/32	79.9	44.8	71,800	78.8	176	161	136
Delfos 531C	1783	567	31.8	1-1/8	73.7	46.7	75,000	77.1	189	174	148
Delfos 651	1506	480	31.9	1-1/8	71.3	43.6	76,100	78.8	159	146	124
Deltapine 14	1725	665	38.6	1-3/32	75.8	38.8	75,100	80.5	198	182	157
Miller	1625	583	35.9	1-1/32	58.5	51.7	74,500	83.0	159	152	136
Rowden (Roldo)	1592	557	35.0	1-1/32	53.8	47.4	79,200	84.8	152	145	130
Stoneville 2B	1930	648	33.6	1-3/32	59.4	42.9	77,300	78.7	201	186	161
Stoneville 2C	1783	574	32.2	1-1/8	64.0	36.8	75,200	79.2	188	172	146
Wilds 16	1446	451	31.2	1-9/32	67.9	48.6	86,700	77.4	175	158	120
Dif. barely significant	154	62	.6	1/32	2.7	6.8	2,700	3.5	18	16	13
Dif. highly significant	204	81	.8	1/32	3.5	9.0	3,600	4.6	23	21	18

each of two samples from each variety at each location, with the exception of Yazoo City. Free fatty acids and foreign matter determinations were based upon one analysis of each of two samples from each variety at each location, with the exception of Yazoo City. Analyses of the Yazoo City samples were not made, and average values for seed from the other six locations were used in determining money value per acre, since it was definitely determined that the average values were more representative of the actual value of the seed than a flat 100 basis would be at Yazoo City. As far as the authors know, this is the first attempt to evaluate cotton varieties by taking into consideration the respective seed analyses.

Differences required for significance between varietal averages are based upon the residual error in the analyses of the individual locations and the locations x varieties interaction in the analyses of the combined locations. These values are found in the bottom two lines of the tables. The differences between any two varietal averages in a column must be equal to or exceed the amounts found at the bottom of the table in order to be considered significant.

The 1944 growing season was characterized by a marked deficiency of soil moisture during the boll maturation period. The lengths of the fast-fruiting cottons, Bobdel, Coker 100-8, and the Delfos strains, were affected more by dry weather than were the lengths of the slower maturing varieties.

Good stands were obtained at all locations.

Stoneville Test

The Stoneville test was located at the Delta Branch Experiment Station and was conducted in cooperation with J. W. Whitaker, county agent of Washington County. The soil is a sandy loam typical of banks along upper Deer Creek. A nitrogenous fertilizer was "bedded-on" about 2 weeks before planting. The test was planted on April 25. The first picking was made on August 29, and the second picking on October 6. Results of the Stoneville test are given in table 1.

Stoneville 2B, Stoneville 2C, Deltapine 14, Bobshaw 1, and Coker 100-8 were leading money value producers.

Tunica Test

In cooperation with Mrs. F. P. Farrell, landowner, and D. D. Gibson, county agent, a variety test was conducted in the northern part of the Delta in Tunica County, 1 mile south of Tunica on Highway 61. The soil is derived from Mississippi alluvium and was classified as Dundee silt loam, or number 435, as described in the Tunica County soil survey bulletin 381 of the Mississippi Experiment Station. A nitrogenous fertilizer was "bedded-on" prior to planting on May 17. Application of fertilizer and date of planting were delayed because of excessive spring rainfall. Seedlings did not emerge until June 4. The plants fruited unusually late. A first picking was made on October 10, a second picking on November 7, and a third picking on January 20. The results of the Tunica test are given in table 2.

Leading money value producers were Stoneville 2B, Deltapine 14, Coker 100-8, Delfos 531C, Bobshaw 1, and Stoneville 2C.

Money Test

A test was conducted in Leflore County, near Money, in cooperation with H. L. Gary, president of Wildwood, Inc., and J. S. McBee, county agent. The soil varies from a fine sandy loam to a silt loam, and an influence of outwash from the hills exists. It is fairly representative of the light soil of the Tallahatchie River Basin. A heavy growth of hairy vetch was turned under, and nitrogenous fertilizer was "bedded-on" before planting. After the cotton had been thinned and "worked out," it was side-dressed with 20 pounds of nitrogen. The test was planted on May 2. The first and second pickings were made on September 7 and

Table 3. Money cotton variety test, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	Inches	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols.
Bobdel	1962	622	31.7	1-1/8	70.0	59.2	84,800	78.1	200	184	159
Bobshaw 1	2285	775	33.9	1-3/32	66.6	51.8	83,000	78.6	235	218	190
Coker 100-8	1788	658	36.8	1-3/32	69.2	49.1	79,800	73.1	197	181	156
Delfos 444	2017	581	28.8	1-5/32	81.5	58.5	75,600	75.9	208	190	156
Delfos 531C	1813	593	32.7	1-1/8	76.2	58.6	80,800	74.5	197	180	152
Delfos 651	1819	597	32.8	1-1/8	73.2	54.8	81,100	73.7	197	180	152
Deltapine 14	1932	769	39.8	1-3/32	72.9	48.5	76,900	81.2	221	205	178
Miller	1842	665	36.1	1	58.7	56.9	81,100	81.7	179	171	154
Rowden (Roldo)	1888	676	35.8	1	55.7	49.7	82,600	84.6	181	173	156
Stoneville 2B	2158	742	34.4	1-3/32	61.8	51.5	82,400	76.7	230	212	182
Stoneville 2C	2071	681	32.9	1-1/8	64.2	48.5	80,600	75.0	219	200	171
Wilds 16	1451	457	31.5	1-1/4	68.3	47.1	90,900	73.5	174	157	120
Dif. barely significant	177	62	.6	1/32	1.8	5.4	2,400	3.2	19	18	15
Dif. highly significant	234	81	.8	1/32	2.4	7.2	3,200	4.2	26	23	20

Table 4. Heathman cotton variety test, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	Inches	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols.
Bobdel	1139	372	32.7	1-3/32	84.3	69.4	82,000	75.1	113	106	93
Bobshaw 1	1435	491	34.2	1-1/16	82.3	76.0	81,800	77.9	144	135	119
Coker 100-8	1215	450	37.0	1-1/16	87.3	67.6	78,200	74.9	127	119	104
Delfos 444	1259	373	29.6	1-1/8	94.7	79.8	76,200	73.7	125	115	98
Delfos 531C	1058	351	33.2	1-3/32	93.9	78.5	77,200	71.1	108	101	88
Delfos 651	1089	362	33.2	1-3/32	89.7	72.4	76,800	71.8	110	102	90
Deltapine 14	1264	506	40.0	1-1/16	85.2	61.9	73,800	76.1	139	131	115
Miller	1363	506	37.1	1	69.8	69.2	76,900	78.5	136	129	117
Rowden (Roldo)	1298	475	36.6	1	60.0	66.1	78,600	78.2	126	120	108
Stoneville 2B	1473	507	34.4	1-3/32	75.4	72.9	79,700	74.2	150	140	123
Stoneville 2C	1355	457	33.7	1-3/32	80.4	69.1	79,800	71.9	142	131	113
Wilds 16	1228	399	32.5	1-1/4	76.7	50.6	84,100	69.5	148	133	103
Dif. barely significant	87	33	.6	1/32	2.3	3.9	2,800	3.0	10	9	8
Dif. highly significant	116	44	.8	1/32	3.1	5.2	3,700	4.0	13	11	10

Table 5. Valley Hill cotton variety test, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	Inches	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols
Bobdel	774	248	32.0	1-3/32	76.0	72.9	82,600	77.2	77	72	63
Bobshaw 1	784	269	34.3	1-1/16	74.6	67.7	80,900	77.0	78	74	66
Coker 100-8	697	257	36.9	1-1/16	77.4	72.9	75,300	74.6	73	69	60
Delfos 444	736	218	29.6	1-1/8	84.7	71.9	71,800	74.2	71	66	57
Delfos 531C	680	223	32.8	1-1/8	83.8	67.5	75,000	73.0	73	67	57
Delfos 651	752	247	32.8	1-3/32	80.5	63.6	75,700	75.9	78	72	63
Deltapine 14	759	297	39.1	1-3/32	81.6	51.3	74,400	79.5	86	80	70
Miller	597	216	36.2	1	71.6	62.1	74,300	80.4	58	56	50
Rowden (Roldo)	485	170	35.1	1	66.0	58.9	78,300	79.4	46	44	39
Stoneville 2B	911	316	34.7	1-3/32	69.7	61.2	77,200	75.6	93	88	78
Stoneville 2C	691	229	33.2	1-3/32	73.5	64.8	79,200	75.0	71	66	58
Wilds 16	484	149	30.7	1-1/4	80.2	60.4	84,800	70.3	56	51	40
Dif. barely significant	92	32	.7	1/32	2.7	6.2	2,600	2.7	10	9	8
Dif. highly significant	122	43	1.0	1/32	3.6	8.2	3,400	3.6	13	12	10

Table 6. Yazoo City cotton variety test, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	Inches	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols.
Bobdel	2168	715	33.0	1-1/16	80.2	83.6	83,300	77.1	212	200	177
Bobshaw 1	2642	962	36.4	1-1/16	73.7	75.9	82,800	78.0	270	256	227
Coker 100-8	2344	900	38.4	1-1/16	79.3	74.1	78,200	74.1	250	235	207
Delfos 444	2317	709	30.6	1-3/32	93.1	77.9	75,600	76.0	227	210	183
Delfos 531C	2340	805	34.4	1-3/32	86.4	82.9	79,000	72.7	247	229	200
Delfos 651	2401	826	34.4	1-3/32	82.9	82.3	77,800	73.7	243	229	202
Deltapine 14	2430	1016	41.8	1-1/16	83.2	74.8	76,600	80.2	272	258	228
Miller	2390	911	38.1	1	66.7	79.6	78,900	79.1	241	230	207
Rowden (Roldo)	2343	858	36.6	1-1/32	59.2	66.7	82,600	80.3	229	219	197
Stoneville 2B	2610	958	36.7	1-1/16	69.8	77.4	79,200	76.5	269	255	226
Stoneville 2C	2572	918	35.7	1-1/16	72.3	75.3	81,500	74.8	264	249	219
Wilds 16	2197	729	33.2	1-1/4	75.6	66.3	88,000	70.2	268	242	188
Dif. barely significant	129	50	.5	1/32	2.5	3.1	2,300	2.6	15	13	11
Dif. highly significant	170	66	.7	1/32	3.3	4.1	3,100	3.5	19	18	15

Table 7. Kelso cotton variety test, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	Inches	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols.
Bobdel	1915	622	32.5	1-1/8	76.0	81.9	80,600	78.8	201	185	159
Bobshaw 1	2157	757	35.1	1-3/32	70.7	78.1	81.400	80.1	224	209	184
Coker 100-8	2136	792	37.1	1-3/32	74.1	76.4	77,400	77,2	230	214	186
Delfos 444	2105	610	29.0	1-5/32	87.1	70.2	72,100	77.5	211	193	163
Delfos 531C	2286	768	33.6	1-1/8	79.7	82.5	76,400	73.7	249	229	196
Delfos 651	2142	724	33.8	1-3/32	78.0	78.9	76,500	75.9	229	211	183
Deltapine 14	1939	778	40.1	1-3/32	75.4	73.9	73,200	79.9	224	209	183
Miller	2091	774	37.0	1-1/32	63.1	78.5	75,800	81.3	210	201	180
Rowden (Roldo)	2026	723	35.7	1-1/32	55.1	65.9	78,500	83.6	198	189	170
Stoneville 2B	2244	785	35.0	1-3/32	66.0	73.8	78,600	77.8	240	221	193
Stoneville 2C	2064	704	34.1	1-3/32	69.3	77.9	79,700	78.5	217	200	174
Wilds 16	1795	567	31.6	1-1/4	69.3	74.7	88,100	75.1	214	194	150
Dif. barely significant	185	58	.6	1/32	2.6	4.9	1,800	1.9	22	19	15
Dif. highly significant	245	77	.8	1/32	3.5	6.5	2,400	2.5	29	25	20

October 17, respectively. The results of the Money test are given in table 3.

Highest money values were produced by Bobshaw 1, Stoneville 2B, Deltapine 14, and Stoneville 2C.

Heathman Test

The Heathman test, in Sunflower County, was conducted in cooperation with W. J. Godbold, manager of Bobshaw Chemurgic Plantation, and H. A. Carpenter, county agent. The field is located on Highway 82. The soil is a light-colored, well-drained silt loam. A heavy growth of hairy vetch was turned under and a nitrogenous fertilizer was "bedded-on" before planting. The test was planted on May 10, and the first and second pickings were made on September 22 and October 28. The results of the Heathman test are presented in table 4.

Stoneville 2B, Bobshaw 1, Stoneville 2C, and Deltapine 14 were leading money value producers. When comparions were based on low-grade cotton only, Miller was among the leading producers. When comparisons were based upon high-grade cotton only, Wilds was among leading producers.

Valley Hill Test

The Valley Hill test was conducted in cooperation with L. S. Hemphill, landowner, and J. R. Haynes, county agent. The field is located in Carroll County about 6 miles east of Greenwood on Highway 82, and is on the eastern border of the Delta. The surface soil, although it contains some sand, is a light-colored, well-drained, silt loam made up largely of outwash from the hills. A nitrogenous fertilizer was "bedded-on" before planting. The plots were planted on May 15. Boll rot was very bad, particularly on the Wilds 16 and Rowden (Roldo) plots. The first and second pickings were made on September 26 and November 6, respectively. The yield and other data from the Valley Hill test are given in table 5.

Stoneville 2B and Deltapine 14 were the highest money value producers.

Yazoo City Test

In cooperation with Marx Schaefer, landowner, and A. R. Ruby, county agent, the variety test for the southeastern part of the Delta was conducted on the Schaefer farm 3 miles west of Yazoo City. The soil varies from a fine sandy to a silt loam and is well to medium well drained. A nitrogenous fertilizer was "bedded-on" and the test planted on May 11. The first and second pickings were made on September 14 and November 1. The results of the Yazoo City test are given in table 6.

Leading money value producers were Deltapine 14, Bobshaw 1, Stoneville 2B, Wilds 16, and Stoneville 2C.

Kelso Test

The Kelso test was conducted in cooperation with James Hand of Kelso Plantation and C. L. Cary, county agent of Sharkey County. The test is located on the Sharkey-Issaquena county line 11 miles south of Cary on Highway 61. The soil is a very productive fine sandy loam derived from Mississippi alluvium and is typical of the Deer Creek soil of Sharkey, Issaquena, and Warren Counties. The test was planted on May 9. It is unique in that it is, as far as the Station staff knows, the first cotton variety test to be planted in check rows. The rows were 40 inches apart each way and were cultivated with four-row equipment exclusively. Six plants were left in each hill. Very little rain fell during the growing season. Boll weevil infestations were very heavy, and the cotton was dusted several times. The first and second pickings were made on September 21 and October 30, respectively. The yield and other data from the Kelso test are given in table 7.

Highest money value producing varieties were Delfos 531C, Stoneville 2B, Coker 100-8, Delfos 651, and Bobshaw 1. Deltapine 14 was among the leading

Table 8. Yield and other data from cotton variety tests conducted at seven locations in the Yazoo-Mississippi Delta, 1944.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq. in.	Pct.	Dols.	Dols.	Dols.
Bobdel	1704	549	32.2	35.3	75.6	69.2	83,000	78.2	172	160	139
Bobshaw 1	1943	670	34.5	34.6	71.7	64.0	82,300	78.8	198	186	163
Coker 100-8	1759	649	36.9	34.9	75.3	63.5	78,300	75.4	189	175	153
Delfos 444	1797	525	29.2	36.2	86.4	66.9	74,700	76.7	178	164	139
Delfos 531C	1748	576	33.0	35.8	81.8	68.6	77,700	73.9	186	171	147
Delfos 651	1705	566	33.2	35.4	79.1	64.7	78,000	75.0	178	165	143
Deltapine 14	1772	709	40.0	34.6	78.2	57.0	75,500	79.9	201	188	164
Miller	1757	645	36.7	32.0	64.4	65.9	77,700	81.0	174	166	149
Rowden (Roldo)	1727	618	35.8	32.6	57.8	58.8	80,400	82.1	168	160	144
Stoneville 2B	1991	692	34.8	34.9	66.5	62.0	79,800	76.8	208	194	169
Stoneville 2C	1871	629	33.6	35.3	70.0	61.4	80,100	75.9	195	181	156
Wilds 16	1522	486	31.9	40.0	73.2	57.6	87,900	72.8	184	166	127
Dif. barely significant	105	43	.5	.3	2.4	4.5	1,000	1.2	12	11	9
Dif. highly significant	140	57	.7	.4	3.1	6.1	1,400	1.6	16	14	12

money value producers when comparisons were based on low-grade cotton only.

Combined Tests

The average values for the yield and other data from the seven tests are given in table 8. While these averages supply general and interesting information, it should be borne in mind that there are limitations to their use. A farmer who grows cotton under a set of conditions similar to that under which a variety test at a certain location was conducted would obtain considerably more information for his own use by studying the performance of the various varieties at that location than he would by observing the average values obtained in the combined analyses of data from tests at several locations. Yield and other data from the combined analyses of variety tests conducted at the seven locations are given in table 8.

Stoneville 2B, Deltapine 14, and Bobshaw 1 were leading money value producers.

Summary

Cotton variety tests were conducted in 1944 by the Delta Branch Experiment Station at Stoneville, Tunica, Money, Heathman, Valley Hill, Yazoo City, and Kelso.

Stoneville 2B and Deltapine 14 were among the top money value varieties at all locations. Stoneville 2C was one of the higher money producing strains at Stoneville, Tunica, Money, Heathman, and Yazoo City. Bobshaw 1 was in the top group in regard to money value at Stoneville, Tunica, Money, Heathman, Yazoo City, and Kelso. Coker 100-8 was one of the leading varieties at Tunica and Kelso. Delfos 531C led the other varieties at Kelso and was one of the top varieties at Tunica. Delfos 651 was one of the leading varieties at Kelso. When comparisons are based upon low-grade cotton only, Miller was one of the leading varieties at Heathman. When comparisons are based upon high-grade cotton only, Wilds 16 was one of the leading varieties at Heathman and Yazoo City. When the money value data from the seven tests were analyzed in the combined analysis, it was found that Stoneville 2B, Deltapine 14, and Bobshaw 1 were leading money value producers.

In the combined analyses, information was provided relative to the average staple length, earliness, fiber bundle strength, and fiber length uniformity for the 12 varieties.

The staple lengths for most of the varieties were shorter than normal. Wilds 16 was 1-1/4 inches long. Bobdel, Delfos 444, Delfos 531C, Delfos 651, and Stoneville 2C were in the 1-3/32 to 1-1/8 inch group. Bobshaw 1, Coker 100-8, Deltapine 14, and Stoneville 2B were in the 1-1/16 to 1-3/32 inch group. Miller and Rowden (Roldo) were in the 1 to 1-1/32 inch group.

The earliest cottons were Bobdel, Delfos 531C, Delfos 444, Miller, and Delfos 651. Late varieties were Deltapine 14, Wilds 16, and Rowden (Roldo), Stoneville 2B and Stoneville 2C.

Outstanding in fiber bundle strength were Wilds 16, Bobdel, and Bobshaw 1.

The fiber length uniformity of Rowden (Roldo), Miller, Deltapine 14, Bobshaw 1, and Bobdel were better than those of the other varieties included in the study.

Two new features of these studies were the use of seed analyses in determining the money value produced by the respective varieties and the planting of the Kelso test in check rows. As far as the Delta Station staff knows, this is the first time that these features have been incorporated in cotton variety tests.

SWEET WILLIAM PHLOX

Wild Flowers of MISSISSIPPI

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director

ATE COLLEGE MISSISSIPPI

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WILD FLOWERS

OF

MISSISSIPPI

FERRIS S. BATSON
Associate Horticulturist

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WILD FLOWERS OF MISSISSIPPI

By Ferris S. Batson and George W. Johnston

Relatively few people appreciate the wealth of wild flowers found in Mississippi. The variation in soils, climate, and environment provides suitable conditions for growth and development of a great variety of plants. Since there is such an abundance of native materials well adapted to conditions in the State, a greater quantity of the more attractive wild flowers should be used in the home landscape. The value of native plants is often overlooked since poorly shaped, sparse-blooming plants usually result from growth in the woods in crowded places or poor soil. Cinderellas of the woods often change into princesses when brought into cultivation.

This bulletin has been prepared to help nature lovers and gardeners identify wild flowers of the State and to encourage their use in landscape plantings. Although this publication lists relatively few of the native herbaceous plants, many of the species that are more desirable for cultivation have been described.

TRANSPLANTING

In transplanting from the woods, observation should be made as to the kind of soil in which each plant is growing, and the soil conditions should be duplicated whenever possible in setting plants in the landscape. Observe the fertility, type, and moisture content of soil. Also notice whether plants grow in sun, shade, or both sunny and shady situations. Success or failure in growing many wild flowers depends on whether or not the gardener follows this practice. The fact that many plants grow in a wide range of conditions should not be overlooked.

Bulbous plants are generally transplanted more successfully after the blooming season when the foliage begins to turn yellow. Plants that have fibrous roots that grow near the surface are generally easy to transplant at any time. Those that have sparsely branched roots growing deep into the soil are more difficult to transplant, and preferably plants having this kind of root system should be moved during fall or winter. Plants are often difficult to locate when not in bloom; however, these may be found if well marked with stakes or tags during the blooming season. If plants are moved during the blooming season it is usually desirable to cut off the tops a few inches above the surface of the ground so that the reduced root system can supply the remaining leaves with water. Leave as much soil as possible around the roots when transplanting during the growing season.

STARTING FROM SEEDS

In many cases it is easier to establish plantings of wild flowers from seeds. Seeds should be collected from plants when mature and dry, just before the reproductive structure containing the seeds opens releasing them. The chief difficulty in collecting seeds is in being able to find them at the right stage for gathering.

When collected and cleaned, place the dry seeds in envelopes, seal, and label. Envelopes should then be placed in a glass jar which is free of moisture, and the jar kept closed. Keep in a cool place until time to plant.

Seeds may be sown directly in the wild garden or cultivated garden. The soil where seeds are to be sown should be dug up, pulverized so as to be free of clods and the surface smoothed. Sow seeds on the surface and press gently into the soil with the shoe or a board. Fine seeds do not need covering. Larger seeds may be covered slightly (not more than 1/16 inch) with sifted sandy loam. September and October is the best time to sow seeds of most wild flowers.

Higher percentages of seed germination may be had by starting seed in a seed flat as in handling many cultivated flower and vegetable seeds.

CONSERVATION

Promiscuous removal of native plants from the woods should not be tolerated. Plants should **never** be removed when located near a highway or farmstead. Respect the rights of others by always asking permission of the owner before collecting flowers or plants on areas not frequented.

BOTANICAL DESCRIPTIONS AND PLANT NAMES

Botanical descriptions of plants have been written in non-technical language so that high school students and amateurs can readily understand them. As far as possible only the conspicuous parts of the flowers, chiefly the petals and sepals, have been used in the descriptions of the flowers. The botanical descriptions have been simplified from the following publications:

"Cyclopedia of Horticulture", by L. H. Bailey; "Illustrated Flora of Northern United States and Canada", by N. L. Britton and A. Brown; "Manual of Weeds", by Ada Georgia; "Manual of Botany", by Asa Gray; and "Manual of Southeastern Flora", by J. K. Small.

"Standardized Plant Names", second edition, has been followed in naming plants. Synonyms of common names are shown in **bold face.**

EXPLANATION OF THE IDENTIFICATION KEY

Only those plants described in this bulletin can be identified by the following key. In order that identifications can be made without detailed study, only readily observed characters of flowers, stems, and leaves are used. As far as possible, technical terms have either been omitted entirely or replaced by terms familiar to ev-

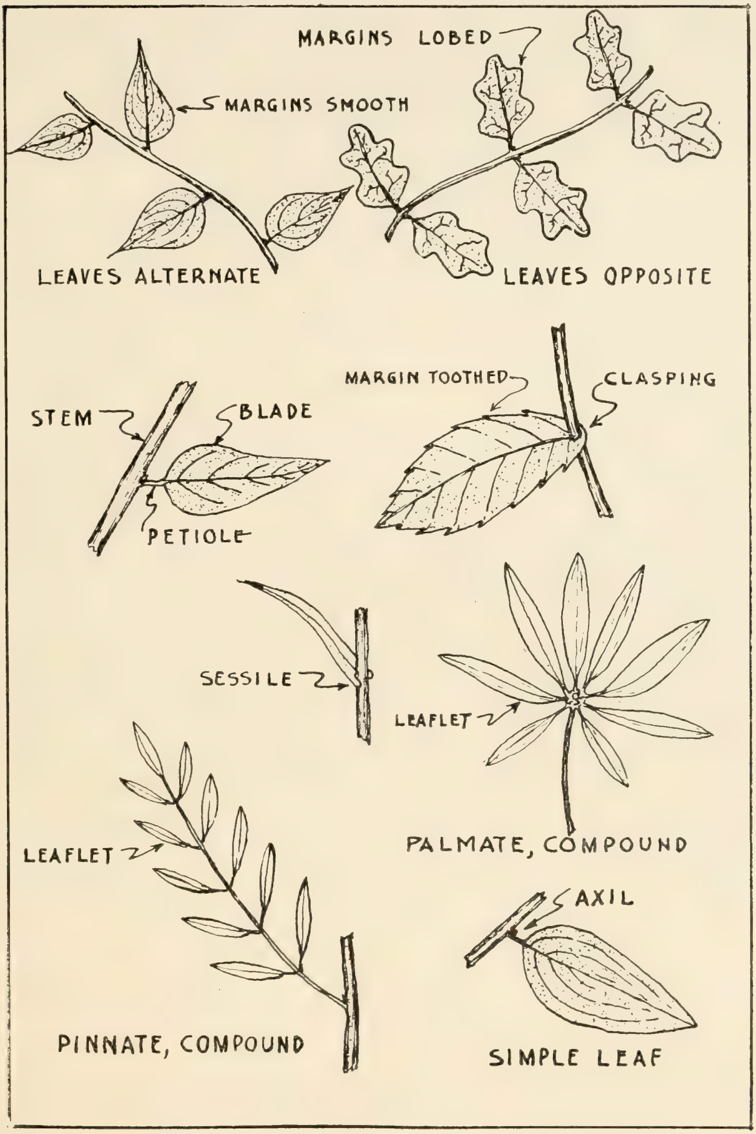
MARGINS LOBED
MARGINS SMOOTH
LEAVES ALTERNATE
LEAVES OPPOSITE
MARGIN TOOTHED
CLASPING
STEM
BLADE
PETIOLE
SESSILE
LEAFLET
LEAFLET
PALMATE, COMPOUND
AXIL
PINNATE, COMPOUND
SIMPLE LEAF

Figure 1—Leaf Characters

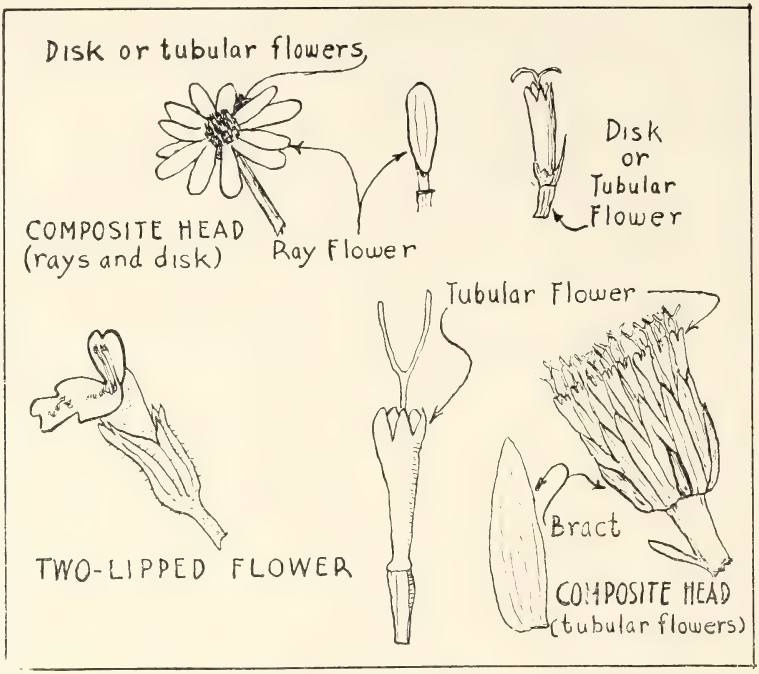
Disk or tubular flowers
COMPOSITE HEAD
(rays and disk)
Ray Flower
Disk
or
Tubular
Flower
Tubular Flower
TWO-LIPPED FLOWER
Bract
COMPOSITE HEAD
(tubular flowers)

Figure 2—Flower Types

eryone. Before attempting to use the key, one should carefully observe the drawings of leaf and flower types on pages 5 and 6.

The key is based on a system of alternatives; i. e. for every set of positive descriptive characters there is an alternate set of negative characters having the same number. Thus the plant in question must fit into one of two classes. This system can best be illustrated by carrying a plant through the key. Suppose one is identifying the Birdsfoot Violet. Since it has a flower, it cannot be a fern; thus it belongs in Division II. The flowers are not in composite heads; therefore, one looks for the alternative which is the second 1. The plants do not grow in water, therefore, it falls under the second 10. The flowers are not surrounded by a hooded tube; therefore, it falls under the second 12. The flowers are not divided into 3 or 6 parts; therefore, it falls under the second 13. The leaves are all from the base of the flower stalk; therefore, it falls under the first 27. The leaves are not hollow, trumpet-shaped, hooded; therefore, it falls under the second 28. Then, by referring to the page indicated, a complete description and photograph of Birdsfoot Violet will be found.

IDENTIFICATION KEY

DIVISION I. FERNS

1. Leaves generally in threes from the summit of an erect stalk .... **Bracken Fern**

1. Leaves not in threes from the summit of an erect stalk

    2. Leaf stem (rachis) winged, plants smooth .... **Netvein Chainfern**

    2. Leaf stem not winged, plants covered with rusty wool .... **Cinnamon Fern**

DIVISION II. FLOWERING PLANTS

1. Flowers many, small, in a composite head surrounded by leaf-like bracts (head appearing as a single flower as in asters, daisies, etc.)

    2. Small flowers all alike (tubular), rose-purple .... **Spike Gayfeather**

    2. Small flowers not all alike (rays surrounding disk)

        3. Flower heads solitary on end of main stem and branches

            4. Leaves opposite (rays yellow, disk brown) .... **Bigflower Coreopsis**

            4. Leaves alternate

                5. Lower leaves in mat around base of stem (rays white, disk yellow) .... **Oxeyedaisy**

                5. Lower leaves not in mat around base of stem

                    6. Disk cone-shaped, rays entire, drooping, purple .... **Purple Echinacea**

                    6. Disk not cone-shaped, rays five parted, purplish-blue .... **Stokesia**

        3. Flower heads not solitary (few to many)

            7. Heads in dense clusters

                8. Leaves finely divided, strong-scented .... **Common Yarrow**

                8. Leaves not finely divided or strong-scented .... **New England Aster**

            7. Heads not in dense clusters

                9. Rays bright-orange, disk brownish-purple, cone shaped .... **Blackeyedsusan**

                9. Rays violet or white, disk yellow, not cone-shaped .... **Savoryleaf Aster**

1. Flowers not in composite heads surrounded by bracts
  10. Plants usually growing in water
    11. Leaves long, sword-shaped; flowers in long, brown spike .... **Common Cattail**
    11. Leaves broad, petioled; flowers in yellow, tapering spike .... **Goldenclub**
  10. Plants not usually growing in water (sometimes in wet areas)
    12. Flowers on stalk surrounded by leaf-like, hooded tube .... **Indian Jack-in-the-pulpit**
    12. Flowers not surrounded by hooded tube
      13. Flowers divided into 3 or 6 parts (petals or petals and sepals)
        14. Leaves all from base of stem or flower stalk
          15. Flowers solitary .... **Atamascolily**
          15. Flowers not solitary (few to many)
            16. Flowers with an erect, six-angled crown .... **Key Hymenocallis**
            16. Flowers without a crown
              17. Flowers in clusters on end of stem
                18. Flowers blue with yellow eye .... **Common Blue-eyedgrass**
                18. Flowers greenish-white or yellowish white .... **Yellow Falsegarlic**
                18. Flowers pink with dark midvein .... **Canada Garlic**
              17. Flowers not in clusters on end of stem
                19. Flowers small with six equal segments (sepals and petals) .... **Atlantic Camas**
                19. Flowers large with six unequal segments
                  20. Flowers blue .... **Blueflag Iris**
                  20. Flowers copper-colored .... **Copper Iris**
        14. Leaves not all from base of stem
          21. Leaves alternate
            22. Flowers inconspicuous (nodding, greenish, six-lobed tubes) .... **Small Solomonseal**
            22. Flowers conspicuous
              23. Flowers divided into six showy parts

24. Flowers spurred, golden yellow .... **Yellow Fringeorchid**

24. Flowers not spurred, whitish-green .... **Crow Poison**

23. Flowers divided into three showy parts .... **Spiderwort**

25. Plants covered with long hairs .... **Hairy Spiderwort**

25. Plants not covered with long hairs .... **Spiderwort**

21. Leaves 3, in a whorl at top of stem (petals 3, purple, leaf-like curved upward)........................ **Prairie Trillium**

13. Flowers divided into 4 or 5 parts (except in **Mayapple** 6 or 9)

25. Leaves all from base of flower stalk

27. Leaves hollow, trumpet-shaped, hooded.. **Trumpet Pitcherplant**

27. Leaves not hollow, trumpet-shaped, hooded.. **Birdsfoot Violet**

26. Leaves not all from base of flower stalk

28. Leaves alternate

29. Leaves simple

30. Leaves finely-divided, flowers spurred.. **Larkspur**

30. Leaves not finely-divided, flowers not spurred

31. Petals 4

32. Leaves toothed, smooth, flowers white or pink .... **Showy Primrose**

32. Leaves not toothed, hairy, flowers yellow .... **Meadow Sundrop**

31. Petals 5

33. Flowers tube-shaped, two-lipped (bright red) .... **Cardinalflower**

33. Flowers not tube-shaped, two-lipped

34. Leaves toothed

35. Flowers in clusters on end of stem.. **Crimsoneye Mallow**

35. Flowers alternate on upper part of

stem (yellow or white)....**Moth Mullein**

34. Leaves not toothed

    36. Flowers in dense clusters on ends of stem and branches (bright orange)........ .... **Butterfly Milkweed**

    36. Flowers in loose clusters along upper part of stem (blue)........**Willow Amsonia**

29. Leaves compound (flowers shaped like sweet peas)

    37. Leaves palmately compound

        38. Leaflets 1 (appearing as a simple leaf)........... .... **Lady-lupine**

        38. Leaflets 3.......................... **Atlantic Wildindigo**

        38. Leaflets 7-11 .... **Sundial Lupine**

    37. Leaves pinnately compound

        39. Flowers greenish-cream color..........**Milkvetch**

        39. Flowers yellow and pink or yellow and purplish-blue .... **Virginia Tephrosia**

28. Leaves opposite (forked in **Mayapple**)

    40. Leaves toothed or divided

        41. Leaves finely divided

            42. Flowers bluish-purple or lilac-purple............... .... **Dakota Verbena**

            42. Flowers rose-purple, pink or white.................. .... **Moss Verbena**

        41. Leaves not finely divided

            43. Flowers in clusters (two-lipped)

                44. Flower clusters on stalks arising in axils of upper leaves................................**Penstemon**

                44. Flower clusters on ends of stem and........... branches .... **Wild Bergamot Beebalm**

            43. Flowers not in clusters

                45. Leaves large, umbrella-like, deeply-lobed .... **Common Mayapple**

                45. Leaves not large, umbrella-like deeply-lobed

                    46. Flowers two-lipped, the upper lip hood shaped .... **Hyssop Skullcap**

46. Flowers two-lipped, the upper lip not hood-shaped .... **False Dragonhead**

40. Leaves not toothed or divided

47. Plants with milky sap

48. Flowers greenish-purple or pinkish .... **Common Milkweed**

48. Flowers white .... **White Milkweed**

47. Plants without milky sap

49. Flowers tube-shaped at base, five-parted at top

50. Leaves sessile (lower sometimes petioled in **Silene)**

51. Flowers on single or clustered spikes (scarlet outside, yellow inside) .... **Pinkroot Spigelia**

51. Flowers not on spikes

52. Flowers in clusters .... **Phlox**

53. Plant hairy

54. Hairs sticky, flowers blue .... **Sweetwilliam Phlox**

54. Hairs not sticky, flowers purple, pink, or white .... **Downy Phlox**

53. Plant not hairy, flowers pinkish- purple to white .... **Smooth Phlox**

52. Flowers not in clusters

55. Petals deep-scarlet, two-parted .... **Firepink Silene**

55. Petals rose-pink, not parted .... **Rose-gentian**

50. Leaves petioled, flowers blue or bluish-purple .... **Ruellia**

49. Flowers not tube-shaped at base

56. Leaves only two, narrow, elongate, plants less than a foot high .... **Virginia Springbeauty**

56. Leaves many, not narrow, elongate, plants more than a foot high (flowers pink with yellow eye) .... **Squarestem Rose-gentian**

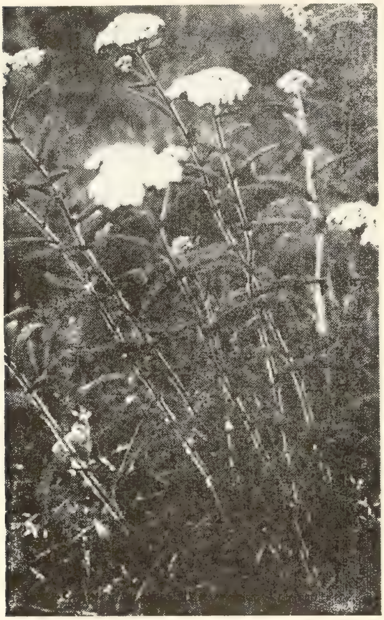

Figure 3—Common Yarrow

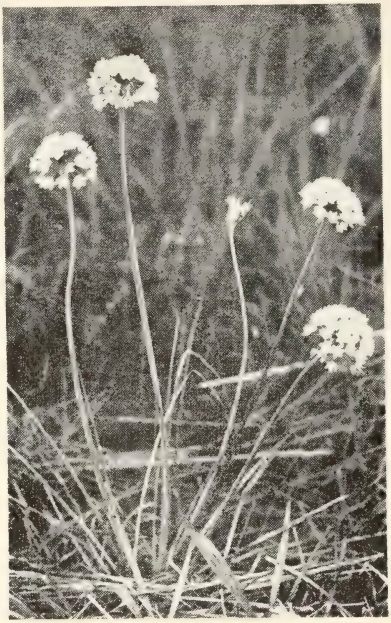

Figure 4—Canada Garlic

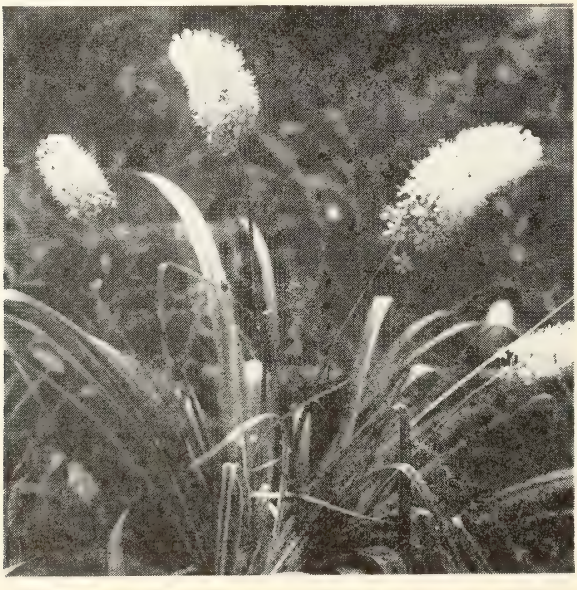

Figure 5—Crow Poison

DESCRIPTION OF PLANTS

COMMON YARROW, Milfoil

Achillea millefolium

Although this perennial has been naturalized from Europe, it is so common in most localities that it appears to be native. Plants have been cultivated to some extent, particularly those producing pink blooms instead of the usual white flower. Found in many sections of the State in sunny situations. Abandoned fields, pastures, woods, and dry hillsides are the places where it is most commonly found. Easily transplanted.

Stem erect, 1 to 2½ feet tall, nearly smooth to cobwebby-haired, sometimes forked toward top. **Leaves** alternate, dark-green, the lower ones finely divided, the upper ones less finely divided, shorter, and narrower than the lower ones; foilage strong-scented. **Flower** heads numerous, small, in dense flat-topped clusters, each flower head consisting of 5 to 12 white or pink rays surrounding a yellowish-white disk. Mid-spring, occasionally later.

CANADA GARLIC

Allium canadense

A common bulbous perennial often found in large masses in southern part of State. Although the blooms are attractive it probably would be rather difficult to eradicate in the cultivated garden. Grows in sandy soil in sun or partial shade.

Stem lacking. **Leaves** few, arising at base of flower stalk, the blades flat, narrow, up to 10 inches long. **Flowers** produced in dense, flat-topped clusters on end of green, leafless, smooth flower-stalk, 8 to 20 inches tall; each flower consisting of six pink segments with a darker central stripe (midvein). April-May.

CROW POISON, Flypoison

Amianthium muscaetoxicum

With care under cultivation this bulbous perennial is handsome during the blooming season. It is an excellent plant for sandy soil. Commonly found in the Longleaf Pine Area of South Mississippi. It prefers full sun or partial shade. Transplant bulbs in late summer or fall.

Stem erect, somewhat angled, 1 to 4 feet tall. **Leaves** grass-like, many at the base of the stem, few toward the top; the lower leaves long and flat, erect or arched, the upper ones much shorter and narrower. **Flowers** rather densely arranged along end of stem, each consisting of six spreading, white segments that gradually turn green with age; the lower, first-blooming flowers often green before the upper flowers open. April-May.

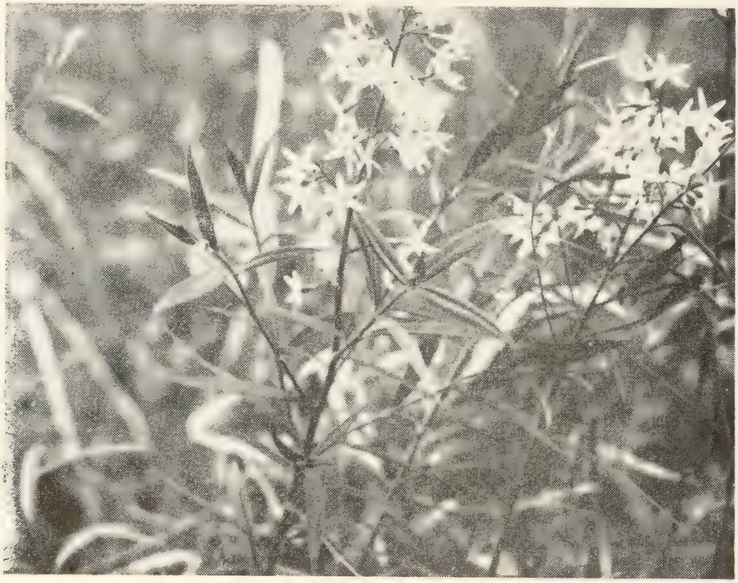

Figure 6—Willow Amsonia

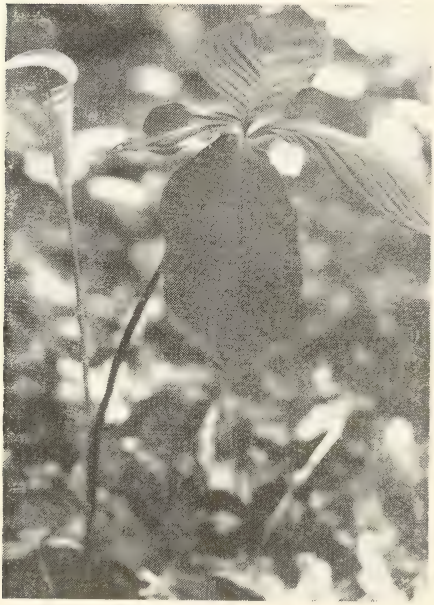

Figure 7—Indian Jack-in-the-Pulpit

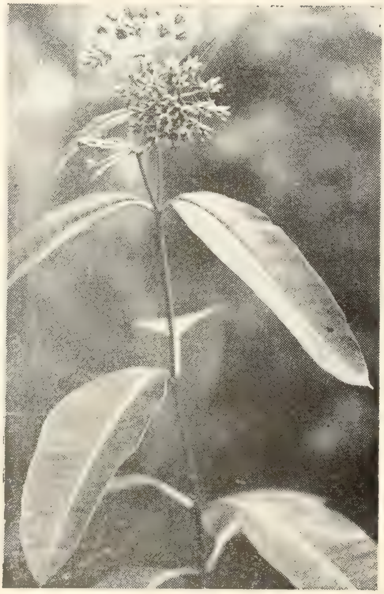

Figure 8—Common Milkweed

WILLOW AMSONIA, Texas-star

Amsonia tabernaemontana

Although this perennial often makes a large attractive clump in the woods, it is much more handsome when given care. A desirable plant for the wild garden and popular in the cultivated garden where it has been used. Several species found in the State are desirable for cultivation. Found in woods and along roadsides, in sunny or shady locations. Easily transplanted.

Stem erect, 2 to 4 feet tall, usually branched toward top, partially covered with short hairs when young, smooth when mature. **Leaves** numerous, simple, alternate, smooth-margined or sometimes finely toothed or bristled on margins near tip, 2½ to 6 inches long, usually lance-shaped with long tapering points, resembling willow leaves. **Flowers** in loose clusters along end of stem, five bluish petals united at their bases into a vase-shaped to funnel-shaped tube. April-May.

INDIAN JACK-IN-THE-PULPIT, Indian Turnip

Arisaema triphyllum

An interesting perennial that is desirable for shady places in the wild garden. The leaves which arise from corms each spring wither and die in summer leaving stalks of bright red fruits. Commonly found in various parts of the State in moist hillsides, thickets, and swamps. Transplant corms in late summer and fall.

Stem lacking. **Leaves** only one or two, erect or nearly so on long petioles 1 to 3 feet tall, the blade divided into three to five egg-shaped, short-pointed segments, pale green on lower surface, darker on upper surface. **Flowers** small, inconspicuous, crowded on the basal portion of a green, club-shaped structure (spadix) enclosed by a green or green and purple-striped, leaflike, tube with a pointed hood or flap arched over the top (spathe). April.

COMMON MILKWEED

Asclepias syriaca

This plant is somewhat coarse to be used extensively in the landscape; however, the rose colored blooms are quite handsome. A perennial rarely cultivated. Found in rich soil, usually bottomland, in various parts of the State. Probably somewhat difficult to transplant.

Stem erect, stout, 2 to 5 feet tall, usually unbranched, downy when young, smooth when mature. **Leaves** opposite, simple, short-petioled, 1½ to 4 inches wide, 2½ to 8 inches long, oblong-lance-shaped to broadly oval, downy on lower surface, smooth on upper surface, the margin slightly rough with short bristly hairs. **Flowers** numerous in clusters on end of stem and axillary flower stalks; each flower consisting of five greenish-purple or pinkish spreading or downward-pointing petals surrounding an erect, five-pointed, purplish or pink crown. May-June.

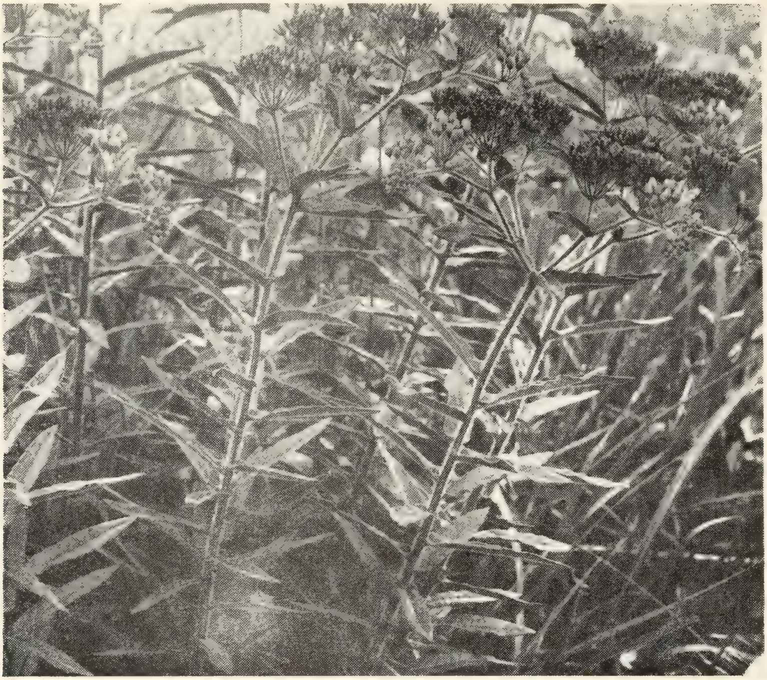

Figure 9—Butterfly Milkweed

BUTTERFLY MILKWEED, Butterfly Weed

Asclepias tuberosa

The Butterflyweed, as it is commonly called, is truly too lovely to be called a weed. This plant, which produces one of the most conspicuous flowers found in the State, usually grows in full sun. It is found more abundantly in open fields and dry banks where the soil contains considerable lime. The roots are somewhat similar to a tuber and grow relatively deeply into the soil. Worthy of wider use as a cultivated plant. It produces seeds rather freely and volunteer seedlings are usually to be found each year where plants are grown in cultivated gardens. Deep rooted and rather difficult to transplant except in winter.

Stem erect or sometimes bent, 1 to 3 feet tall, round, roughish-hairy, leafy, branched toward top. **Leaves** alternate, entire, wavy-margined, oblong to lance-shaped, hairy on both sides, sessile or short-petioled. **Flowers** numerous, in large, flat-topped, bright-orange clusters on ends of branches, each consisting of five downward-pointing petals and a five-parted, erect crown. May-July.

WHITE MILKWEED

Asclepias variegata

Although this perennial has rarely been used in the cultivated garden, it should be satisfactory for this purpose. The white flowers are unusually attractive. Found in dry woods and bottomland in sunny or shady situations. Widely distributed over the State.

Stem erect, 1 to 3 feet tall, smooth or soft-hairy toward top, usually unbranched. **Leaves** opposite, simple, 1 to 2 inches wide, 2 to 5 inches long, short-petioled, oval to egg-shaped, smooth on both surfaces, the margin slightly rough. **Flowers** numerous in dense clusters on end of stem and flower stalks; each flower consisting of five white petals surrounding an erect, five-parted, white crown with a purplish base. May-June.

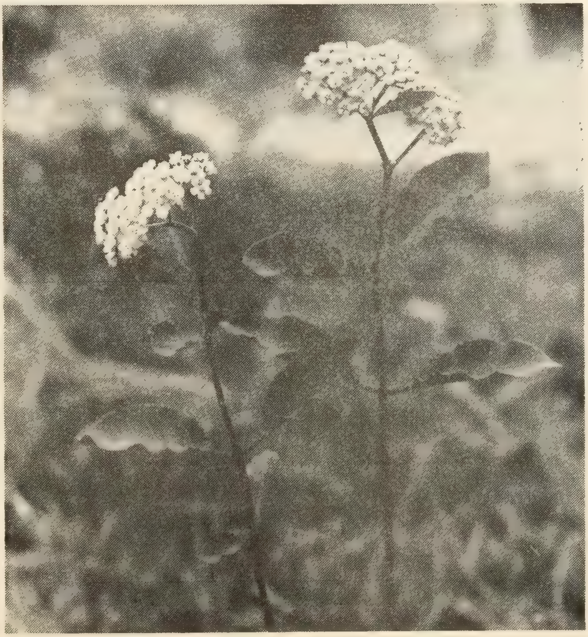

Figure 10—White Milkweed

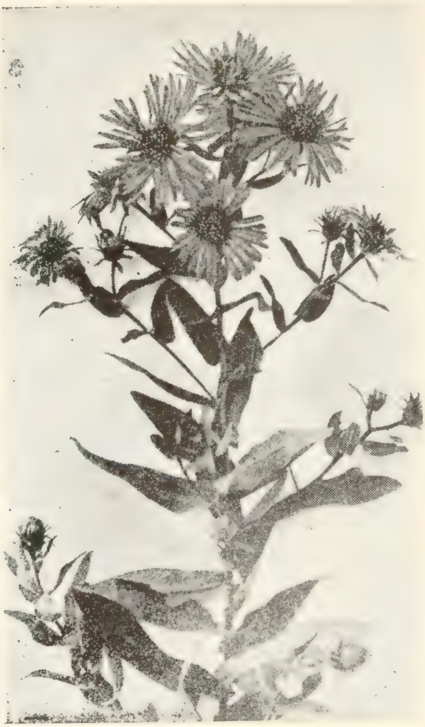

Figure 11—New England Aster

Figure 12—Milkvetch

Figure 13—Savoryleaf Aster

NEW ENGLAND ASTER

Aster novae-angliae

This short-day perennial that blooms as the day length becomes short in the fall, is one of the most attractive of the many native asters. It is found in rich damp soil, fields, edges of thickets, and swamps. Grows in either sunny or shady places. Desirable for the wild garden. Easily transplanted.

Stem erect, stout, 2 to 8 feet tall, branched toward top, covered with bristly hairs. **Leaves** numerous, alternate, lance-shaped, dark-green, smooth-margined, covered with soft hairs, clasping stem at attachment point, 2 to 4½ inches long. **Flower** heads numerous in clusters on tips of stem and branches; each head composed of 40 to 60 long, narrow, violet-purple (sometimes rose or white) rays surrounding an orange-yellow to reddish-brown disk. Fall.

SAVORYLEAF ASTER

Aster (Ionactis) linariifolius

A rather low growing, free blooming perennial that probably would make a desirable subject for the cultivated garden. Usually found in sunny places in dry acid woods, exposed hillsides and pinelands. It occurs in most parts of the State. Apparently easily transplanted.

Stem erect, rough-hairy, leafy, ½ to 2 feet tall. **Leaves** alternate, small, narrow, rough-margined, thickly arranged along stem. **Flower** heads few or only one on end of stem; several violet or white, spreading, somewhat drooping rays surrounding a yellow disk. Fall.

MILKVETCH, Loco, Rattlevetch, Poisonvetch

Astragulus carolinianus

Since this perennial is very difficult to transplant, it is one of the native plants to be enjoyed only in the woods. This plant usually makes a large clump and blooms profusely. Widely distributed throughout the State, more often found in sunny places in dry woods.

Stem erect, 1 to 4 feet tall, smooth or partially covered with hairs. **Leaves** alternate, compound, leaflets 13 to 27, 3/4 to 1½ inches long. **Flowers** numerous, closely packed along leafless end of stem, greenish cream-color, resembling pea blossoms in shape. April-May.

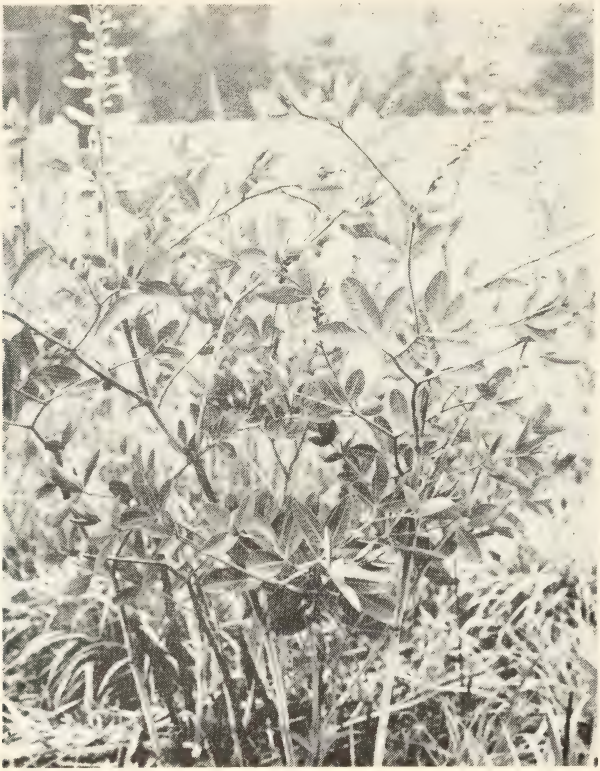

Figure 14—Atlantic Wildindigo

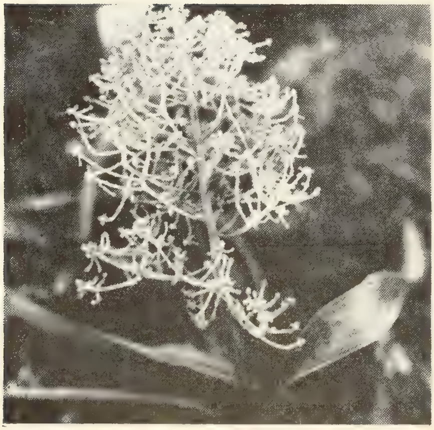

Figure 15—Atlantic Camas

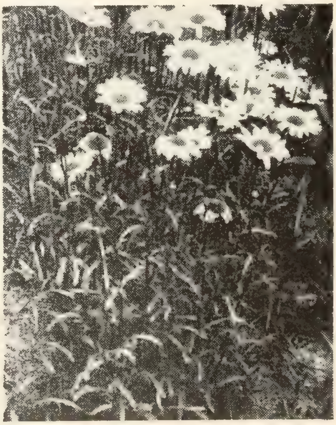

Figure 16—Oxeyedaisy

ATLANTIC WILDINDIGO, White Wildindigo, Prairie Indigo

Baptisia leucanta

One of the wild flowers that is valuable in landscape plantings for its interesting foliage as well as its attractive flowers. Plants allowed to grow undisturbed for several years become shrub-like in size. It is widely distributed throughout the State, occurring in prairies, pinelands, woods, and river banks. Apparently it is well adapted to most well-drained soils. Found in sunny or partially shaded places. Although it has a relatively large root system, it may be transplanted easily. Volunteer plants usually appear in spring where plants are grown in cultivated areas.

Stem stout, up to 4½ feet tall, smooth, often covered with whitish bloom; branches numerous, upward-curving. **Leaves** alternate, compound, leaflets usually three, dark-green, 1½ to 2½ inches long, oblong-wedge-shaped, rounded on end. **Flowers** rather loosely arranged along leafless ends of stems, white in color, resembling garden pea blossoms in shape. April-May.

ATLANTIC CAMAS

Camassia scilloides

The delicate, blue, unique flowers of this bulbous perennial is exceedingly attractive, particularly where masses of them are found in abandoned fields and fence rows. Unusually satisfactory for the cultivated or wild garden. Suitable for sunny or shady situations. Found in thickets and meadows in Central Prairie and Northeast Prairie, possibly elsewhere. Preferably transplant bulbs in fall.

Stem lacking. **Leaves** all basal from an underground bulb, the blades long, narrow, ridged on back like the keel of a boat. **Flowers** small, many, produced along the end of an erect flower stalk 6 to 28 inches tall, the flower stalk leafless except for small, leaf-like bracts; each flower consisting of six blue, spreading segments (sepals and petals). May.

OXEYEDAISY, White Daisy

Chrysanthemum leucanthemum

A plant that was widely distributed through the Southern States during the Civil War and now grows wild in many sections of the State. A perennial that is often called Shasta Daisy because of the similarity of the two plants. Frequently used in yards and gardens. Found more often in sun or partial shade in fields, roadsides, woods, and waste-places. Easily transplanted.

Stem erect, slender, 1 to 3 feet tall, simple or forked toward top, nearly smooth. **Leaves** of lower portion in a mat around base of stem, rounded on end, gradually tapering toward base in outline, the blade divided and irregularly toothed; middle and upper leaves narrowly oblong, sessile, regularly toothed toward tip with large spreading teeth toward base. **Flower** heads single on end of stalk, about 2 inches wide, with 20 to 30 spreading, white rays surrounding a yellow disk. May-June.

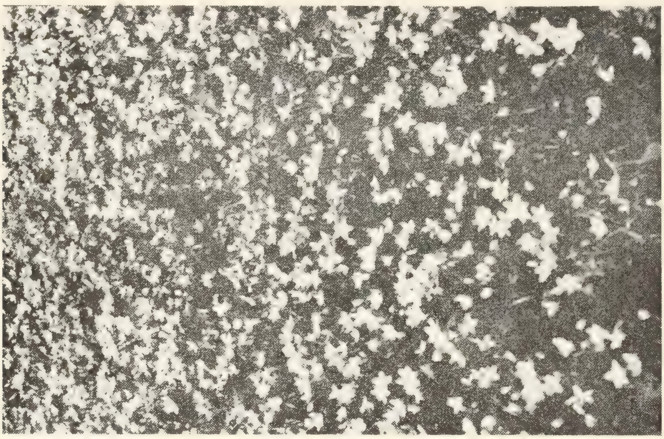

Figure 17—Virginia Springbeauty

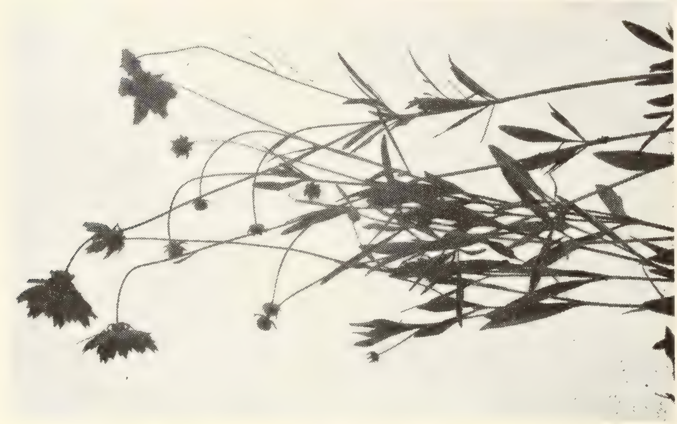

Figure 18—Bigflower Coreopsis

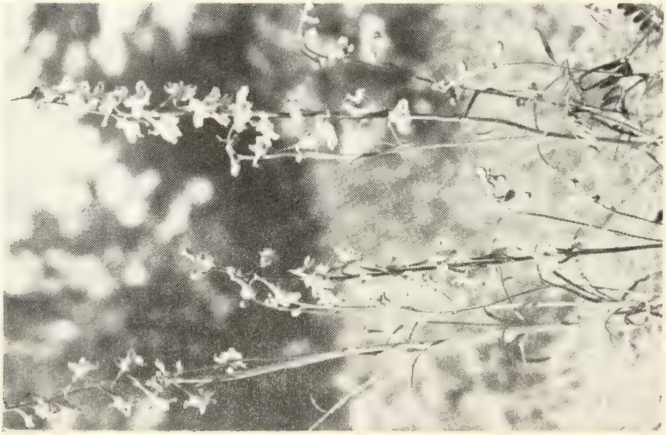

Figure 19—Larkspur

VIRGINIA SPRINGBEAUTY, Springbeauty, Roseelf

Claytonia virginica

One of the daintiest of native perennials, it breaks into bloom quickly during the first warm days of spring. Even though the individual blooms are small the profusion of flowers often produced in large colonies of plants makes a show that reminds one of fairyland. Widely distributed throughout the State in woods, fields, and roadsides. Useful in rock gardens or as an edging plant in the cultivated garden. It is always at home in the wild garden. The corm (bulbous-like root) should be transplanted in summer or fall.

Stem simple, weak, 2 to 8 inches high. **Leaves** only two in number, opposite, narrow, elongated. **Flowers** loosely arranged along upper part of stem, each consisting of five rose-color petals with darker vines; one or two small, green, leaf-like bracts usually present at base of flower stalks. March-April.

BIGFLOWER COREOPSIS, Tickseed

Coreopsis grandiflora

Species of Coreopsis are commonly grown in cultivated gardens throughout the South. This perennial is found in many parts of Central and North Mississippi. Usually found in dry soil in woods and fields exposed to full sun. Easily transplanted.

Stem erect, smooth, 1 to 2 feet tall, simple or branched toward top. **Leaves** opposite, those of lower stem either lance-shaped or gradually widened from narrow base to a round point, usually entire, sometimes lobed; upper leaves divided into three to five parts, each part having two to three lobes. **Flowers** borne in showy heads on ends of stem and branches, each head consisting of several (usually about eight) lobed, yellow rays surrounding a brownish disk. May-June.

LARKSPUR

Delphinium species

This wild flower is quite similar to the common cultivated delphiniums and would be desirable for the cultivated garden or for cut flowers. Apparently it is an annual. Found on dry lands, hillsides, and limestone soil in Northeast Mississippi. Grows best in full sun.

Stem erect, 1 to 3 feet tall, simple or sometimes branches, smooth or covered with soft, short, sometimes sticky hairs. **Leaves** alternate, somewhat finely divided into narrow, thread-like or wider, lance-shaped segments. **Flowers** produced on individual stalks, alternately arranged along the upper part of the stem; each flower consisting of five, petal-like, spreading outer segments, the upper one prolonged into a spur at back (sepals) and two or four smaller, inner, hairy-tipped segments (petals); flowers blue, bluish-purple or sometimes almost white. April-June.

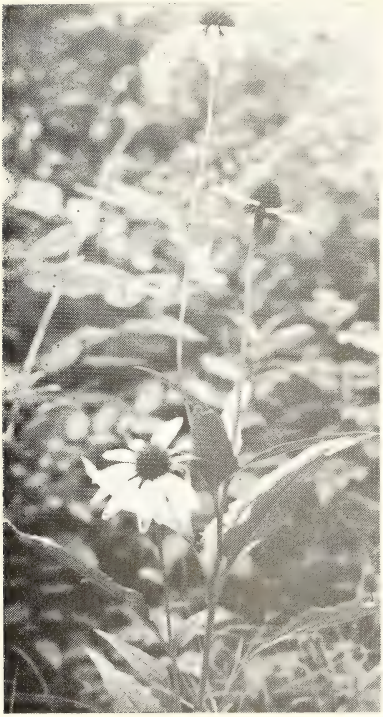

Figure 20—Purple Echinacea

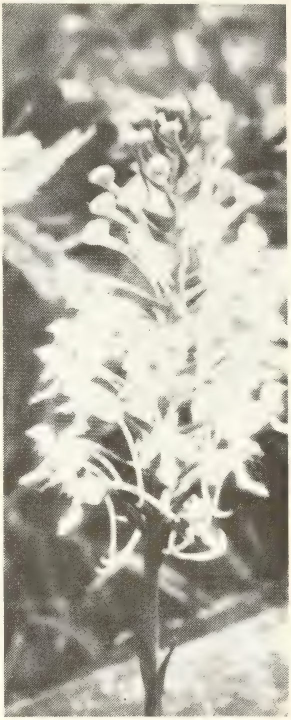

Figure 21—Yellow Fringeorchid

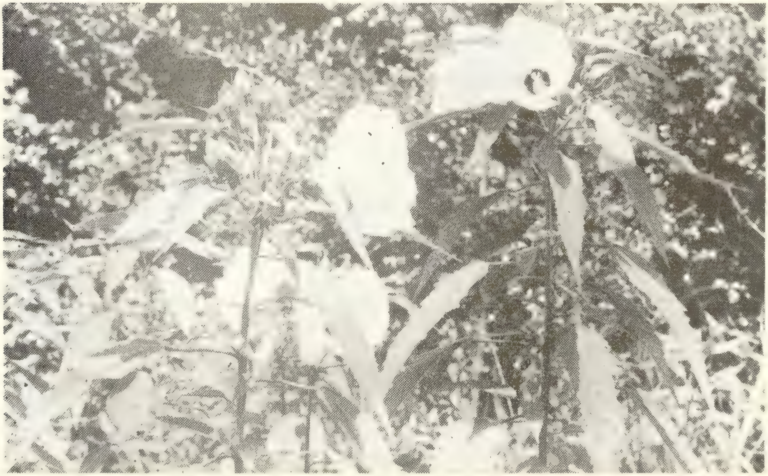

Figure 22—Crimsoneye

PURPLE ECHINACEA, Purple Coneflower, Black-sampson Red-sunflower

Echinacea purpurea

A perennial that is somewhat similar to the coneflower except the flowers are purplish in color. Cultivated to some extent. Usually found in sun or partial shade. Occurs in rich soil, woods, and fields. More common in Northeastern Mississippi. Easily transplanted in fall as the last flowers are fading. Under cultivation, seedlings usually appear near the mother plants in the spring.

Stem erect, slender, 2 to 4 feet tall, rough-bristly, usually unbranched. **Leaves** alternate (sometimes opposite on lower part of stem) dark-green, rough, 3 to 8 inches long, broadest toward base, tapering toward point; the lower ones petioled and toothed, the upper ones sessile and smooth-margined. **Flower** heads produced singly on ends of naked stems with 12 to 20 dull-purple, drooping rays surrounding a deep-purple, cone-shaped disk. July-October.

YELLOW FRINGEORCHID, Orange Plume

Habenaria ciliaris

One of the more common native orchids in this State, particularly in the Longleaf Pine and Central Plain Areas. The flowers which are produced on long stems are particularly desirable for cutflower arrangement but it is doubtful that the plants could be transplanted to the garden to be grown under cultivation. Found in acid bogs, meadows and open woods.

Stem erect, slender, 1 to 2½ feet tall, often slightly zigzag. **Leaves** alternate, oblong or lance-shaped, clasping stem at attachment point; up to 8 inches long at base of stem, much shorter toward top. **Flowers** many, orange or yellow, showy, somewhat crowded along the end of the stem, each flower consisting of six parts in two series of three parts each; two lower lateral segments of the outer series bent backward, the upper middle segment curved forward, somewhat hood-fashion; two upper lateral segments of inner series narrow, toothed at top, and lower middle segment or lip wider and fringed, prolonged into a spur at back. August.

CRIMSONEYE, Rosemallow

Hibiscus oculiroseus

Several species of the rosemallows are common throughout the State. This group of plants produce large showy blooms during summer; however, the plants are rather coarse and weedy for use in the garden. Found in marshes and along roadsides in parts of Central and North Mississippi. Appears to grow best in sunny situations.

Stem erect, leafy, 3 to 6 feet tall. **Leaves** alternate, simple, egg-

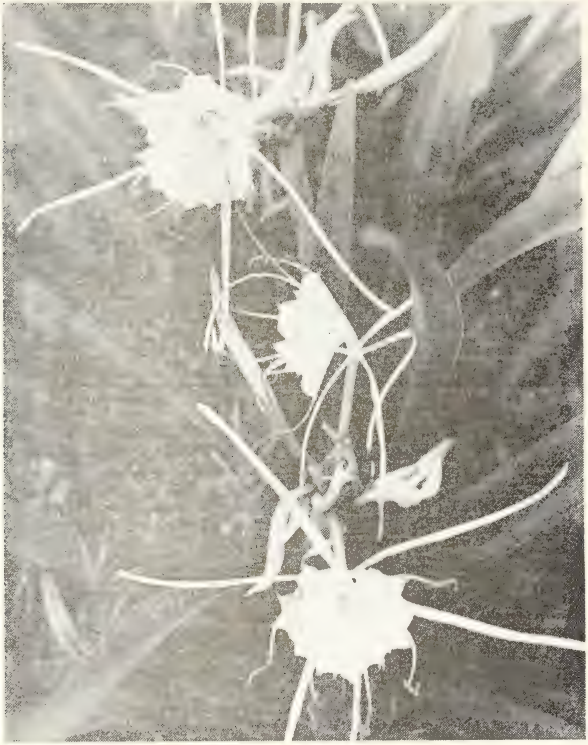

Figure 23—Keys Hymenocallis

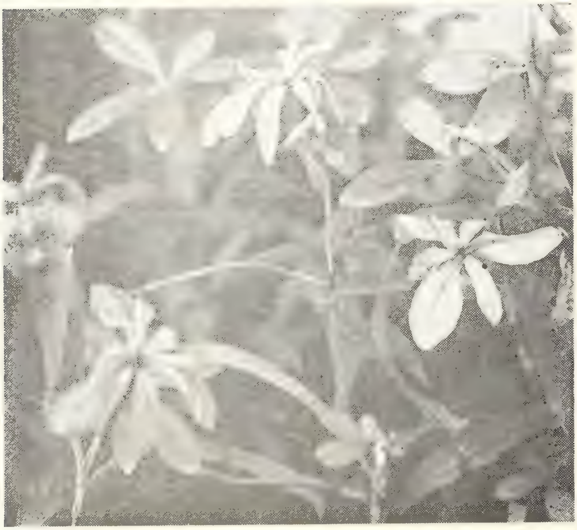

Figure 24—Copper Iris

shaped or lance-shaped, long, tapering, irregularly toothed, long-petioled. **Flowers** large, showy, produced in cluster at tip of stem, each consisting of five white petals with a crimson blotch at base. June-August.

KEYS HYMENOCALLIS, Spiderlily

Hymenocallis keyensis

A bulbous perennial with showy white flowers that deserves a more prominent place in cultivated gardens. Usually found along banks of streams and swamps where soil is well drained. Several similar species are found in the State. It grows well in sun or shade. Bulbs should be dug, divided and transplanted in summer when the foliage turns brown following the flowering period.

Stem lacking. **Leaves** all from base of flower stalk, erect or arching, up to 32 inches tall, smooth, green, strap-shaped with blunt tips, the edges turned upward to form a channel or trough down the middle of the leaf. **Flowers** 10 to 16 in a cluster on top of a somewhat flattened, sharp-edged flower stalk; each flower consisting of an elongated tube divided toward the top into six, rather narrow, white, spreading, drooping segments (sepals and petals) surrounding an erect, white, six-angled crown 1 to 1¾ inches wide; six stalks, 2 to 2½ inches tall, with T-shaped, yellow tops (stamens) projecting above the six sections of the crown. April-May.

COPPER IRIS

Iris fulva

One of the most attractive species of native irises. It has been used to some extent in wild and cultivated gardens of this State. Found in swamps, marshes, bayou banks, and ditches. It seems to thrive best in shady or partially shady situations. Preferably it should be transplanted in late summer or early fall, although it may be moved during the blooming season if handled with care.

Stem erect, stout, 1½ to 4 feet tall, round or angled on one side, often slightly zigzag. **Leaves** erect, sword-shaped, mostly from base of stem, usually shorter than flower stalk. **Flowers** showy, consisting of six bluish-purple to copper-colored or reddish-brown notched segments, the outer three spreading, dropping, the inner three about two-thirds as long as the outer, not quite so spreading or drooping. April-May.

BLUEFLAG IRIS, Larger Blueflag

Iris versicolor

One of the most widespread irises in the South. Like many species of iris, it is found in marshes, swamps, meadows, and stream banks in full sun or shady places. In wet soil where few flowers thrive, this plant grows best. The rhizomes (roots) which grow just beneath the surface send up leaves to form new plants until

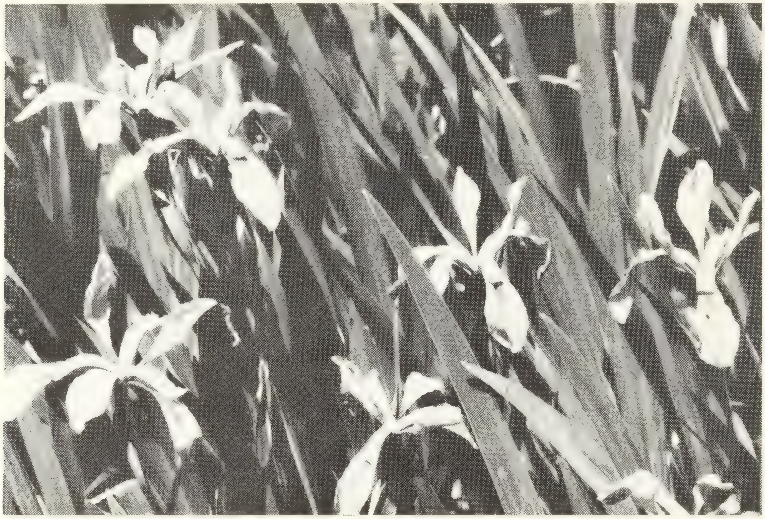

Figure 25—Blueflag Iris

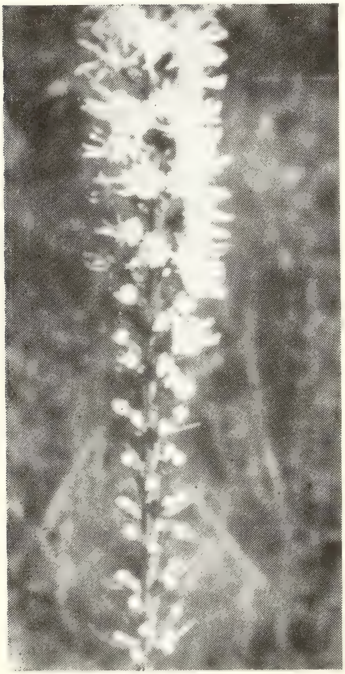

Figure 26—Spike Gayfeather

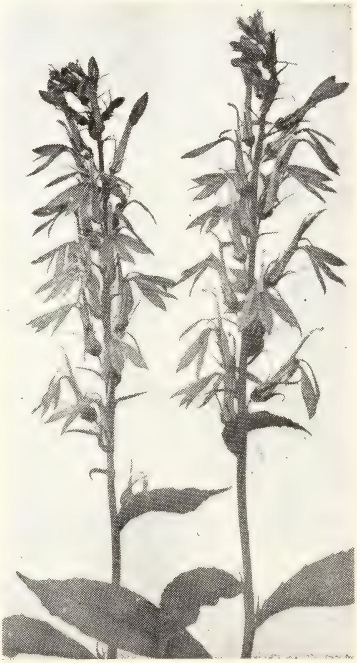

Figure 27—Cardinalflower

eventually the plants spread to make large masses. It may be transplanted easily at any season, but early fall is preferable.

Stem erect, 1 to 3 feet tall, stout, round or sometimes angled on one side, often branched toward top. **Leaves** erect, sword-shaped, mostly on lower part of stem, shorter than flower stalks. **Flowers** several, showy, consisting of six segments united at their base to form a tube, the outer three segments turned downward, violet-blue with yellow, green, and white stripes toward the base, the inner three segments shorter and narrower, violet-blue except for a greenish-yellow base. April -May.

SPIKE GAYFEATHER

Liatris spicata

Due to its attractive flower spike, excellent keeping quality, and long stem, the various species of Gayfeather are frequntly used in floral arrangements. Often grown in the cultivated garden. Perennial. Usually found in sun or partial shade. The many similar species are widely distributed over the State in prairies, moist woods, and low pinelands. Transplant the tuberous-like roots in fall and winter.

Stem erect, 1½ to 5 feet tall, smooth or somewhat hairy, stout, leafy. **Leaves** alternate, long, narrow, stiff, not divided or toothed. Flower heads numerous, thickly arranged along end of stem; each head composed of 8 to 12 small rose-purple, five-parted tube-shaped or funnel-shaped flowers; each small flower surrounded by a ring of erect bristles; the flower head surrounded by close-fitting, scale-leaf-like bracts (involucre). Summer.

CARDINALFLOWER, Lobelia

Lobelia cardinalis

Often illustrated and listed in seed and nursery catalogues, this is a plant that has frequently found its place in the cultivated garden as a conspicuous summer-blooming plant. A perennial that grows equally well in sunny or shady places. Usually found in rich bottomland, swamps, and on banks of streams. Occurs rather infrequently over a wide area of Central and North Mississippi. Easily transplanted.

Stem erect, 1 to 4 feet tall, unbranched, smooth or slightly hairy. **Leaves** alternate, simple, oblong, largest toward middle, tapering toward end, 2 to 6 inches long, the upper leaves smaller than the lower. **Flowers** loosely arranged along end of stem, bright-red, tube-shaped at base, divided into two lips at top, the upper lip erect, narrow, two-lobed, the lower lip drooping, spreading, three-lobed. June-August.

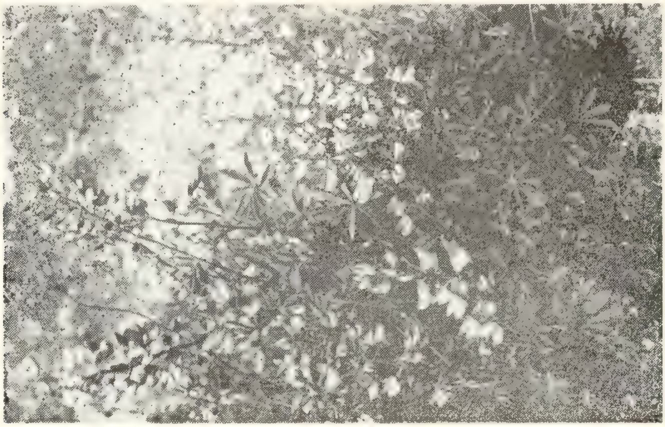

Figure 28—Sundial Lupine

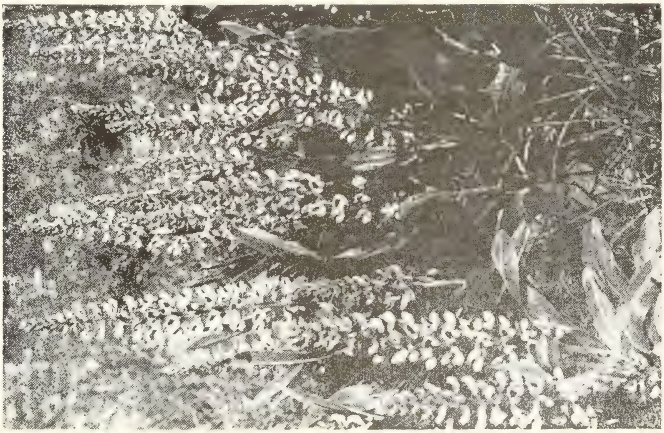

Figure 29—Lady-Lupine

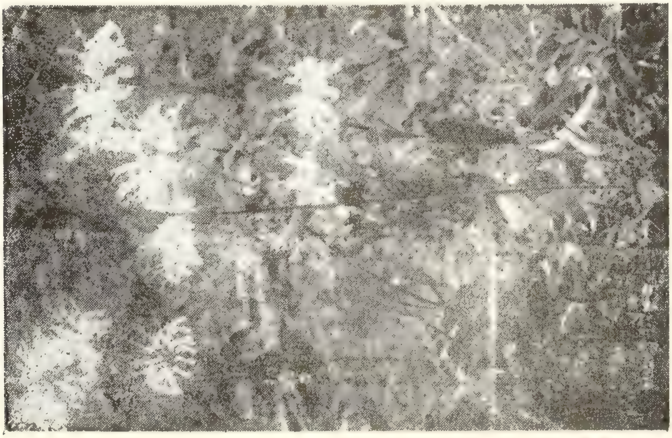

Figure 30—Wild Bergamot Beebalm

SUNDIAL LUPINE, Wild Lupine

Lupinus perennis

One of the more attractive native perennials that is often used in the cultivated garden. Not widely distributed over the State, but occasionally found in open woods, fields, and roadsides in acid, sandy soil in southeastern part of State. Apparently prefers sunny locations.

Stem, erect, 8 to 24 inches tall, stout and succulent, slightly hairy, often branched. **Leaves** palmately compound, 7 to 11 leaflets arising from a central point, leaflets narrow at base gradually widening to a rounder or blunt point, the midrib extending beyond the tip as a small, bristly point. **Flowers** numerous, loosely arranged on a long, terminal stalk, the purplish-blue or white blossoms resembling those of peas in shape. April.

LADY-LUPINE, Hairy Lupine

Lupinus villosus

This annual is one of the few plants that grows luxuriantly on the most barren waste land in the Longleaf Pine and Coastal Plain Areas of South Mississippi. It is not uncommon along barren highway banks where other plants are unable to survive. Usually found in full sun. Plants cannot be transplanted successfully. To grow in the garden, gather seeds as soon as the pods dry and sow in late summer or early fall where the plants are to grow.

Stem and branches close together at top of root, often spreading in all directions and lying flat on the ground except for erect flower stalks on their tips. **Leaves** simple, entire, hairy, 1½ to 6 inches long, usually widest toward middle, gradually tapering toward ends, long-petioled. **Flowers** numerous on erect terminal stalks, deep-lilac or purple, resembling the flower of the garden pea in shape. March-April.

WILD BERGAMOT BEEBALM, Wild Bergamot, Horse Mint

Monarda fistulosa

Although this perennial is not as showy as the Oswego Beebalm, which is so often grown under cultivation, it is quite similar to it. Found in dry woods, fence rows, and thickets in central and northern sections of the State. It grows in either sunny or shady situations. Easily transplanted.

Stem erect, 2 to 3 feet tall, slender, hairy or almost smooth, usually branched toward top. **Leaves** opposite, petioled, heart-shaped at base, tapering to long point, coarsely toothed. **Flowers** in thick clusters on ends of stem and branches, lavender or lilac color, elongated, tube-like with an expanded throat, divided into two lips at top, the upper lip erect and entire or only slightly notched, the lower lip divided into three somewhat spreading lobes. April-May.

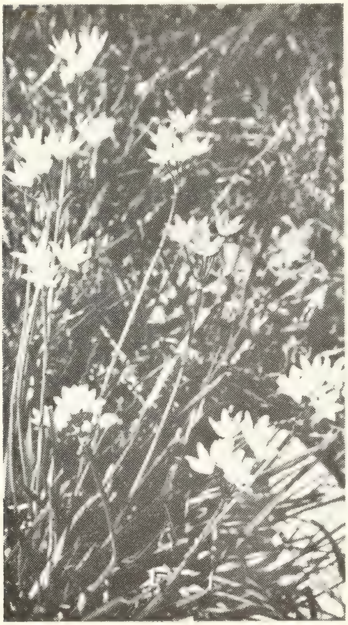

Figure 31—Yellow Falsegarlic

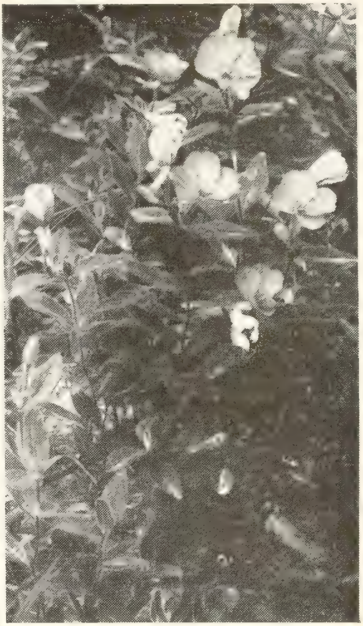

Figure 32—Meadow Sundrop

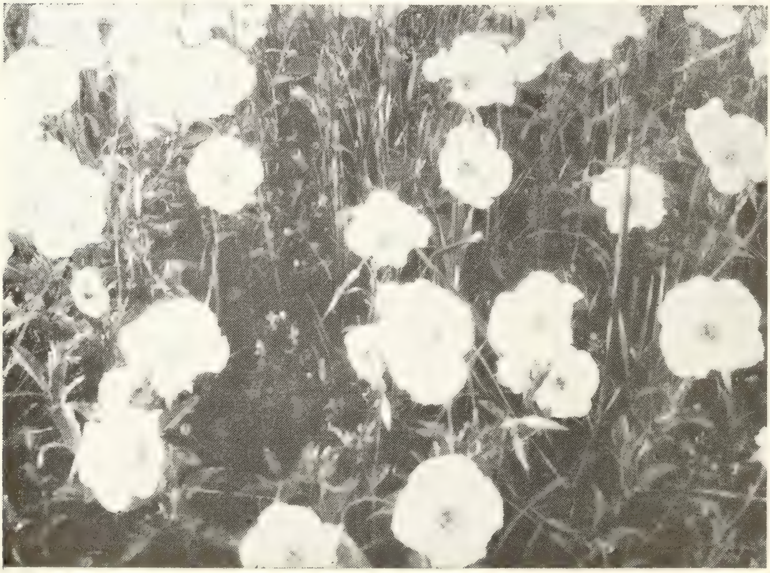

Figure 33—Showy Primrose

YELLOW FALSEGARLIC, Gracegarlic

Nothoscordum bivalve

A bulbous perennial, rarely cultivated, that blooms in early spring. Usually occurs in colonies. Found in fields, open woods, and prairies. Rather widely distrbuted throughout the State.

Stem (flower stalk) slender, 4 to 12 inches tall, leafless. **Leaves** long and narrow, grass-like, from the base of the stem, generally not extending above the flowers. **Flowers** few, borne singly on ends of short individual stalks which are grouped on end of main stalk, each consisting of six greenish-white or yellowish-white petal-like segments; two dry, papery scales on main stalk at base of individual flower stalks. March.

MEADOW SUNDROP

Oenothera pratensis

A rather showy perennial that is attractive for its bright yellow flowers in summer and fall. Found in low ground, woods, and prairies in parts of North Mississippi. Well adapted to sunny situations. Apparently it reseeds readily and probably would be easily transplanted.

Stem erect, 1 to 3 feet tall, covered with long hairs, often zigzag between leaves. **Leaves** alternate, simple, oblong-lance-shaped, hairy on both surfaces, more or less wavy-margined. **Flowers** produced toward top of stem on stalks arising from leaf axils, each consisting of four yellow, notched, somewhat showy petals. Summer-fall.

SHOWY PRIMROSE, Evening Primrose

Oenothera speciosa

The primrose is so abundant in certain sections of the State that it has been suggested that one of the highways should be called the Primrose Trail. This annual is usually found in large masses often blanketing acres of land. Occurs usually in open fields and roadsides. It is more abundant in soils containing considerable lime. Reseeds readily and is likely to become a weed when introduced into cultivated areas.

Stem mostly erect, 8 to 20 inches tall, covered with tiny, soft hairs. **Leaves** alternate, simple, variously shaped in outline: oblong, lance-shaped, round at tip and narrowed toward bottom or long and narrow with parallel edges; leaf blades more or less deeply wavy-toothed. **Flowers** showy, borne singly on end of stem, consisting of four white or rose-colored, fan-shaped, slightly-indented petals. April-May.

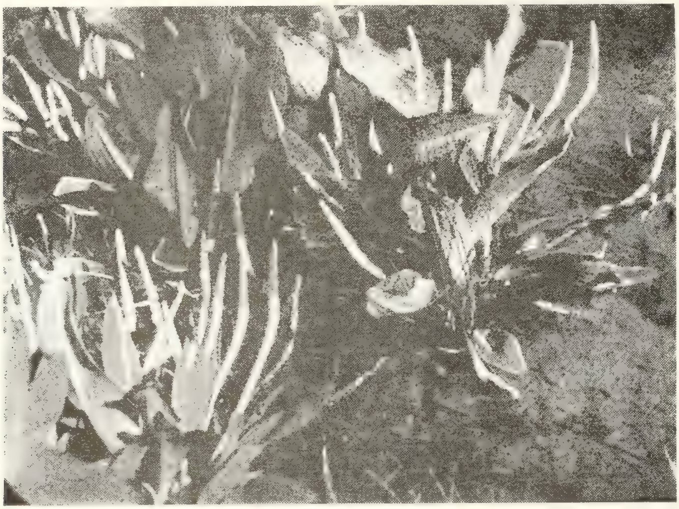

Figure 34—Goldenclub

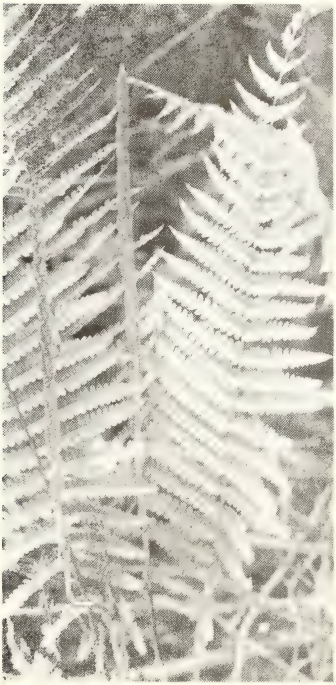

Figure 35—Cinnamon-Fern

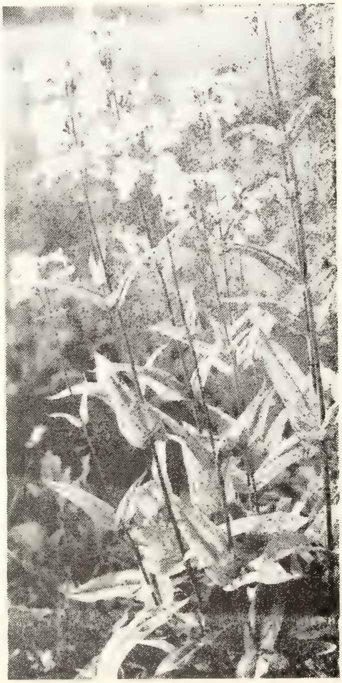

Figure 36—Penstemon

GOLDENCLUB, Neverwet, Waterdock

Orontium aquaticum

The dark green foliage and the contrasting color of the unique, yellow, club-like flowers makes this one of the more attractive water plants. It is particularly common in shallow streams in the southern part of the State. Found in shady or sunny places in streams, ponds, and swamps in many parts of the State.

Stem lacking. **Leaves** arising from a deeply-buried rootstock, oblong, long-petioled, smooth-margined, 4 to 12 inches long, bluish-green in color. **Flowers** numerous, small, scale-like, compactly arranged on the end of the flower stalk forming a golden-yellow, elongate, tapering structure (spadix). Spring.

CINNAMON-FERN

Osmunda cinnamomea

The native ferns are some of the best subjects for the wild garden. The Cinnamon Fern, which is widely distributed over the State, is one of the most attractive. Suitable for planting in moist or wet places. Best adapted to shady situations. Easily transplanted.

Leaves of two kinds, sterile leaves 2 to 5 feet tall, with alternate or opposite branches (pinnae) each divided into numerous oblong, short, round-tipped, connected segments (pinnules); fertile leaves shorter, without leaflets, bearing clusters of cinnamon-colored structures (sporangia) along upper portion of stalk; fertile leaves appearing earlier than sterile and soon withering; both kinds of leaves covered with rusty wool, especially when young.

PENSTEMON, Beard-tongue

Penstemon species

There are many native species of Penstemon in the State that are similar. Although the flowers are interesting in form, the colors are not popular. Usually found in open fields and meadows in full sun or partial shade. Occurs in various sections of the State. Easily transplanted.

Stem erect, unbranched, smooth or soft-hairy, green to purple in color, 1 to 4 feet tall. **Leaves** opposite, the basal ones petioled, the others sessile or clasping, egg-shaped, lance-shaped, or heart-shaped at base, tapering toward point, shallowly-toothed or smooth-margined. **Flowers** in small clusters on stalks arising from axils of upper leaves, each flower inflated, two-lipped, white to purplish tube; the upper lip two-parted, the lower three-parted; the entire inflorescense often glandular-hairy. April-May.

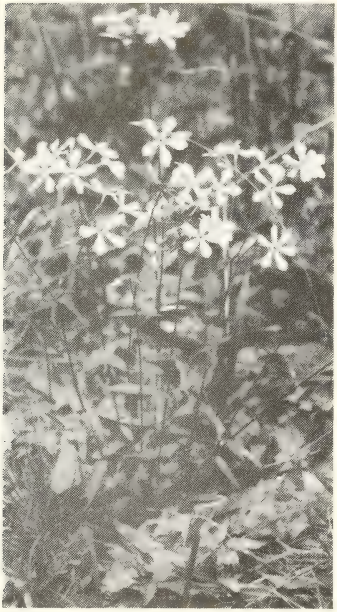

Figure 37—Sweetwilliam Phlox

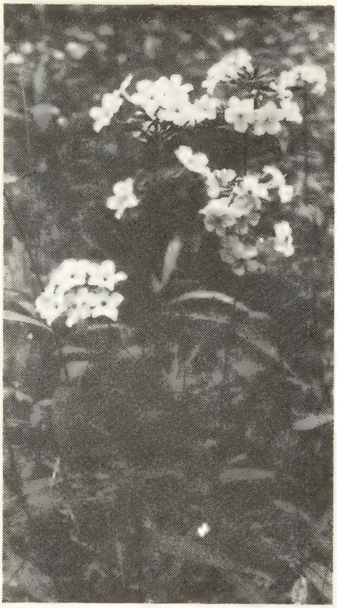

Figure 38—Smooth Phlox

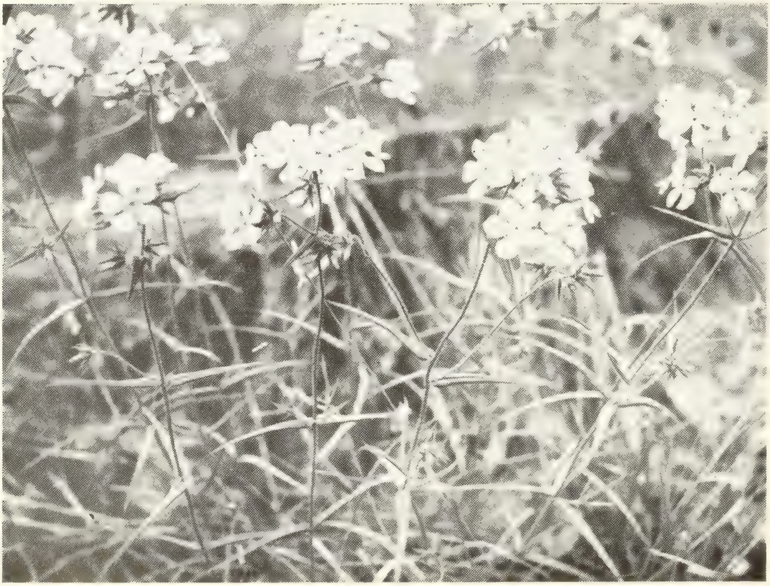

Figure 39—Downy Phlox

SWEETWILLIAM PHLOX, Blue Phlox

Phlox divaricata

This species of phlox has probably been used more than other native phloxes in the cultivated garden. The flowers of this species are more consistently bluish in color than any other phlox. Found in many parts of Central and North Mississippi. More often it occurs in rich bottomlands in shady or partially shady places. Excellent for the cultivated or wild garden. Easily transplanted.

Stems spreading with erect tips or flower shoots up to 20 inches tall. **Leaves** opposite, entire, sessile or nearly so, lance- or egg-shaped, the lower ones sometimes evergreen; entire plant usually covered with fine, sticky hairs. **Flowers** in flat-topped, loosely-arranged clusters, five fragrant, bluish or occasionally lilac petals with faintly violet-striped eye or center spot. April-May.

SMOOTH PHLOX

Phlox glaberrima

This perennial is somewhat similar to other phloxes and should find a place in the garden as a relatively tall-growing plant that blooms in late spring and early summer. Found in many sections of the State in open woods and along roadsides. It is better to collect these plants during the blooming season, since the color of flowers differs and the more desirable colors may be selected. Easily transplanted.

Stems erect, smooth, up to 3 feet tall. **Leaves** opposite, numerous and crowded on lower part of stem, thinner on upper part, elongate to lance-shaped, up to 6 inches long; smooth except around the edge which is rough and often rolled backward. **Flowers** in loosely arranged clusters. Petals pinkish-purple to whitish, the eye or center spot faintly striped. May-June.

DOWNY PHLOX, Sweetwilliam

Phlox pilosa

An attractive perennial that is one of the earliest wild flowers to bloom in spring. Although plants usually produce few flowers in the woods, it blooms profusely when cultivated. This is one of the most desirable wild flowers for the garden. Found abundantly throughout most of the State in open woods thickets, barrens, prairies, and hammocks. Adapted to sunny or shady situations. Easily transplanted even at blooming time. Under cultivation volunteer seedlings are usually to be found each spring.

Stems slender, erect or nearly so, up to 2 feet tall, usually hairy. **Leaves** opposite or alternate, sessile, usually covered with soft hairs on top and bottom surfaces, 1 to 4 inches long, widest at base, tapering to a long, rather sharp point. **Flowers** in a terminal cluster, each consisting of five petals, either purple, pink, or white, with sometimes a purple-striped eye or center spot. March-May.

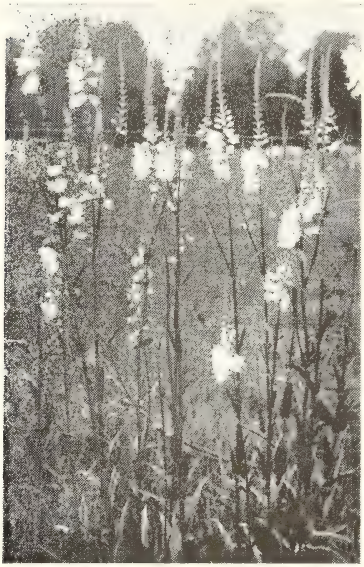

Figure 40—False Dragonhead

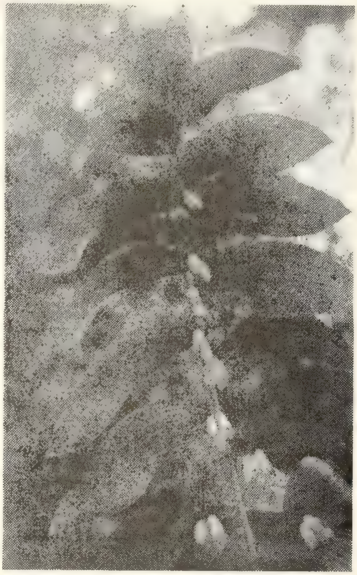

Figure 41—Small Solomonseal

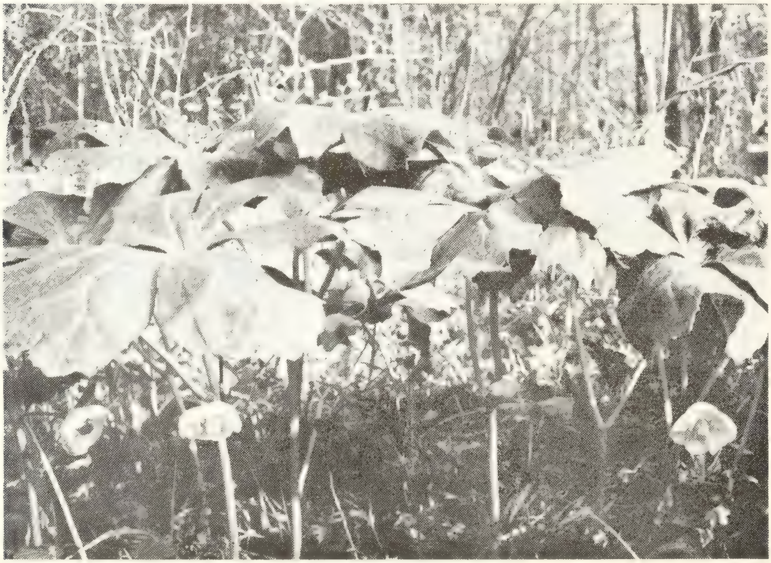

Figure 42—Common Mayapple

FALSE DRAGONHEAD, Obedient Plant

Physostegia denticulata

A perennial that is found in many sections of the State in various types of soil. The orchid colored varieties of False Dragonhead are often grown in cultivated gardens. It more often occurs in open fields, but it is found also in low woods and thickets. Easily transplanted in spring, fall or winter.

Stem erect, square, smooth, 1½ to 4 feet tall, simple or branched into flower stalks at top. **Leaves** opposite, simple, sessile, oblong with rather blunt tip, regularly toothed completely around margin; leaves becoming fewer and smaller from base to top of stem. **Flowers** rather loosely arranged along ends of branches, each an inflated tube divided at the top into two lips. The upper lip entire, the lower three-lobed, the middle lobe larger than the other two and notched; flowers purplish-pink to white. May-June.

COMMON MAYAPPLE, Umbrellaleaf, Wild Mandrake

Podophyllum peltatum

The umbrella-like leaves of this perennial is one of the first wild flowers to make its appearance in spring. It usually grows in moist shady places in swamps and banks of streams where it is more often found in large masses. Found in most parts of the State. The fleshy root is a violent purgative and is said to be poisonous. The roots are easily transplanted and rapidly spread into large clumps under favorable conditions. Well adapted to the shady places in the wild garden.

Stem of two kinds: flowerless stem erect, 1 to 1½ feet high with one large leaf at its tip; flower stem erect with two leaves forked from top. **Leaf** of flowerless stem large, centrally attached, umbrella-like, coarsely divided into five to nine lobes, each lobe further divided into two coarsely toothed parts; leaves of flower stem not centrally attached, one-sided, divided and toothed as leaf of flowerless stem. **Flower** borne on a nodding stalk attached usually in fork of leaves; six to nine white petals, fragrant. April.

SMALL SOLOMONSEAL

Polygonatum biflorum

A perennial that is more attractive for its foliage than flowers. A particularly fine subject for the wild garden. Occurs in various parts of the State in moist thickets, woods along streams, and on bottomlands. It seems to prefer shady places. The thick, horizontal, jointed rootstocks are easily transplanted in fall or winter. Plants usually form large clumps under cultivation.

Stem arched, 8 to 36 inches tall, round, smooth, unbranched, leafless at bottom. **Leaves** alternate or opposite, simple, entire, oblong or egg-shaped, 2 to 6 inches long, dark-green on top, pale on

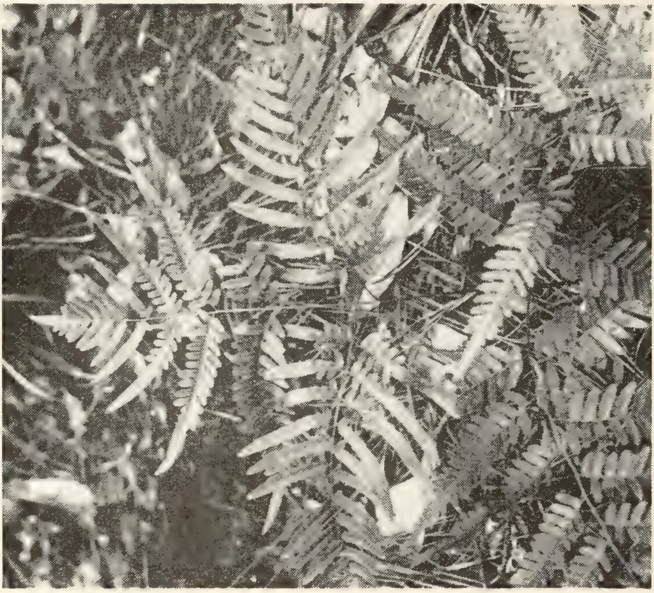

Figure 43—Western Bracken

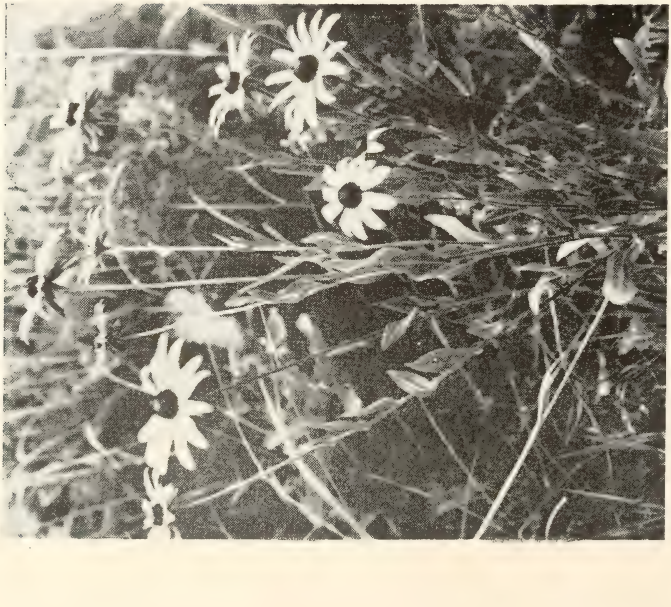

Figure 44—Blackeyedsusan

bottom, sessile or partly clasping the stem at attached point. **Flowers** inconspicuous, small, one to two nodding on each axillary flower stalk, each flower consisting of a whitish-green tube divided into six short lobes at top. April.

WESTERN BRACKEN

Pteridium aquilinum

Although most of the ferns grow best in moist shady places, this is one that is well adapted to dry sunny locations. Widely distributed in the State. Usually found in open woods and along dry banks. Easily transplanted.

Leaves generally in threes from the summit of an erect, stout stalk, 8 to 36 inches tall; each leaf divided into many branches (pinnae); the lowermost branches wide-spreading, with numerous deeply-lobed leaflets (pinnules); the middle, and part of the upper, branches shorter, with undivided or unlobed leaflets; the top-most part of the leaf unbranched, the branches giving way to undivided, short, leaflet-like segments.

BLACKEYEDSUSAN, Yellow Daisy, Coneflower, Niggarhead

Rudbeckia hirta

There are many species of coneflower which are abundant throughout the State. Although these are often a weed, the beauty of masses of yellow blooms is worthy of mention and these plants are among the more abundant species of wild flowers of the State. An annual rarely used in cultivated gardens. Usually found in sun along roadsides, in fields and woods.

Stems erect, rather stout, rough-bristly-hairy, 1 to 3 feet tall, simple or branched toward bottom. **Leaves** alternate, thick, hairy, oblong, smooth-margined or sparingly toothed; the lower ones 2 to 7 inches long, petioled; the upper ones shorter, narrower, sessile and clasped around the stem at attachment point. **Flower** heads few to several on end of main stem and on branches arising from axils of upper leaves, very showy, 2 to 4 inches broad, with about 14 brilliant orange rays surrounding a brownish-purple, cone-shaped disk. April-June.

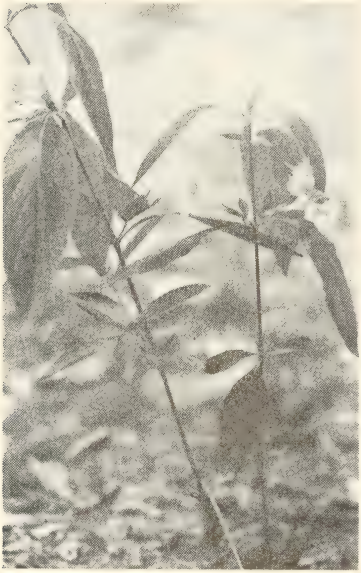

Figure 45—Limestone Ruellia

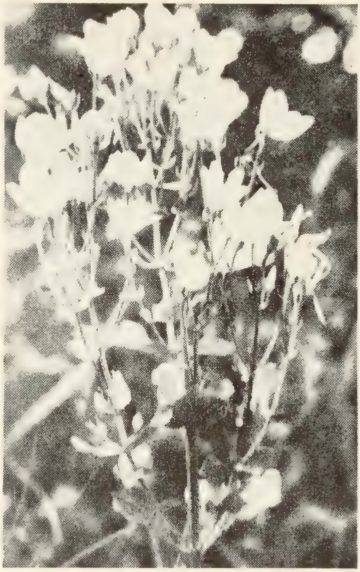

Figure 46—Squarestem Rose-Gentian

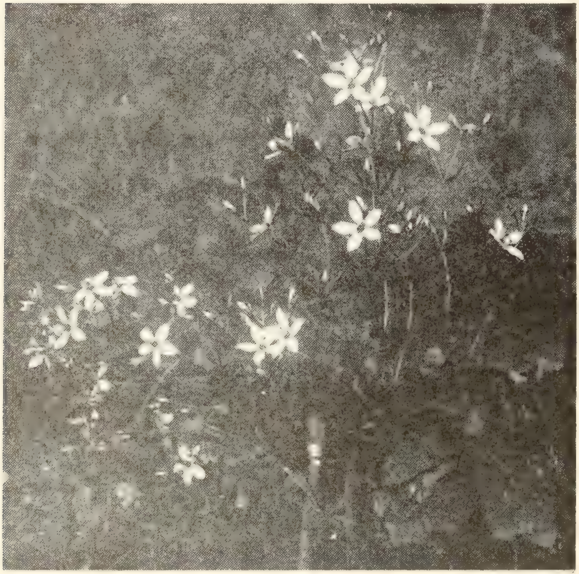

Figure 47—Rose-Gentian

LIMESTONE RUELLIA

Ruellia strepens

Although this plant has only one or two flowers open at one time, it blooms over a relatively long period. A perennial that is well adapted to the shady garden. Found usually in rich bottomland in many parts of the State. Easily transplanted.

Stem erect, square, 1 to 4 feet tall, smooth or sparingly soft-hairy. **Leaves** opposite, simple, petioled, 2 to 6 inches long, oblong to egg-shaped, usually widest toward middle, tapering toward both ends. **Flowers** produced singly on stalks arising in axil of middle and upper leaves, each stalk with two small opposite leaves just below the flower; each flower funnel-shaped, 1¼ to 2 inches long; the lower part of the funnel small, very pale or whitish, the upper part inflated and divided into five, blue or bluish-purple segments. April-June.

SQUARESTEM ROSE-GENTIAN, Rosepink, Bitterbloom

Sabatia angularis

An annual which is very conspicuous in the woods when in bloom. Usually grows where soil is poor in woods thickets and meadows.

Stem erect, 4-angled, 1 to 3 feet high, with numerous opposite branches toward top. **Leaves** opposite, simple, not toothed or divided, egg-shaped, sessile with clasping bases. **Flowers** produced on ends of branches with four to five pink petals having a yellowish or greenish eye; fragrant. Summer.

ROSE-GENTIAN

Sabatia brachiata

This small-flowered plant is rather conspicuous in bloom. Apparently it is an annual. It should be a very satisfactory garden flower; however, it would have to be grown from seeds. Found in many sections of the State in moist soil. Suitable for sunny or shady situations.

Stem erect, 1 to 2 feet tall, smooth, slightly angled, branched toward top. **Leaves** opposite, sessile, entire, somewhat heart-shaped at base, tapering to a rounded point, the upper branch leaves somewhat reduced. **Flowers** produced on ends of branches arising from axils of upper leaves, each consisting of five spreading, rose-pink petals united at their base into a short tube. June-July.

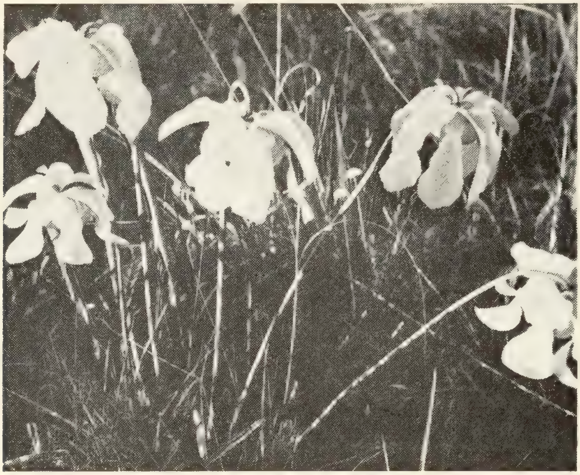

Figure 48—Trumpet Pitcherplant

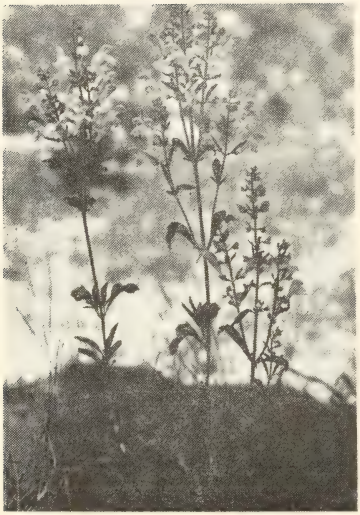

Figure 49—Hyssop Skullcap

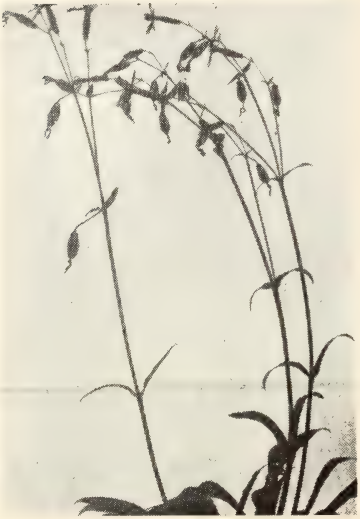

Figure 50—Firepink Silene

TRUMPET PITCHERPLANT, Flytrap, Adam's-pitcher

Devil's Boots, Forefather's Cup

Sarracenia flava

This perennial has not been cultivated and likely it is not suitable for the garden. The showy yellow flowers that appear in early spring are followed by foliage that has the appearance of a pitcher, hence its name. Usually found in meadows, bogs, and marshes.

Stem lacking. **Leaves** erect, 1 to 3½ feet tall, hollow, gradually expanding from the base upward to form a trumpet-shaped, winged structure with a hood at top; the hood sometimes yellow with reddish veins. **Flowers** produced singly on ends of smooth, leafless, nodding flower stalks; each flower consisting of an outer series of five segments, 1½ to 2 inches long, widest in middle and rounded on end (sepals) and an inner series of five drooping, somewhat fiddle-shaped, yellow petals, 2½ to 4 inches long, overhanging a globose of "biscuit shaped", yellowish center. Early Spring.

HYSSOP SKULLCAP

Scutellaria integrifolia

Several species of skullcap that are somewhat similar are found in various parts of the State. Although the group of plants is not striking, many of them are desirable for late spring blooming in the garden. Usually found in sun or partial shade in dry soil. Occurs in most parts of State.

Stem erect, square, 6 to 24 inches tall, branched above middle, covered with short, soft, gland-tipped hairs, specially toward top. **Leaves** opposite, the lower ones petioled with oval to egg-shaped, toothed blades; the upper ones sessile with smaller, smooth-margined blades of varying shapes. **Flowers** oppositely arranged along the end of stem and branches, one arising from the axil of each of the reduced leaves; each flower consisting of a curved tube inflated toward the top and divided into two lips, the upper lip hood-shaped, the lower spreading, notched in center; flowers pale-blue or pale-violet except for white streaks in center of lower lip and on lower surface of tube. May-June.

FIREPINK SILENE, Catchfly

Silene virginica

Because of the firey red color of the flowers of this perennial, it is one of the easiest wild flowers to find in the woods during the blooming season. Found rather sparingly in the woods. A satisfactory plant to use in the cultivated garden. Usually occurs in open woods in sunny or shady situations. Easily transplanted.

Stem erect, slender, 8 to 24 inches tall, enlarged at joints, covered with short, soft, clammy hairs. **Leaves** opposite, entire, thin, mostly

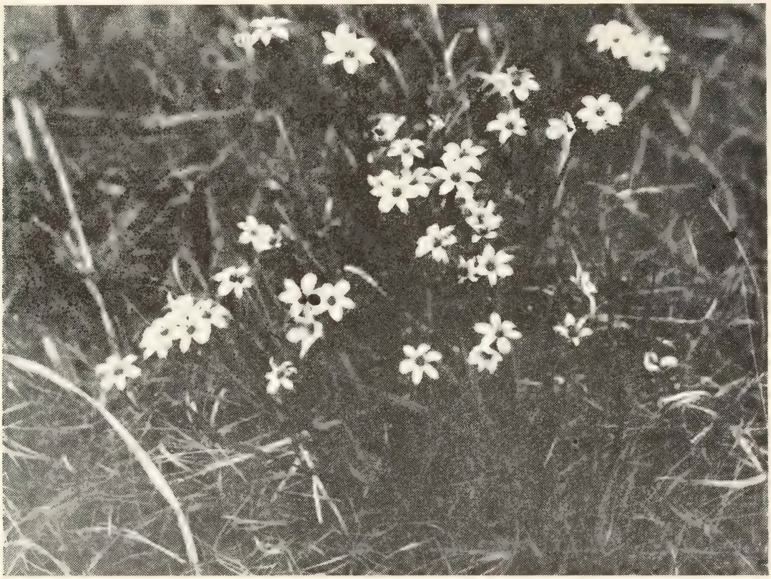

Figure 51—Common Blue-eyedgrass

Figure 52—Pinkroot Spigelia

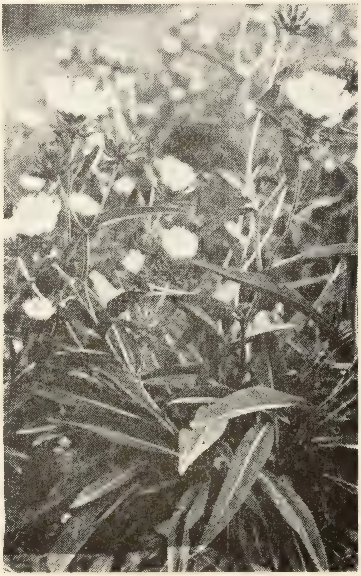

Figure 53—Stokesia

rounded at tip and narrowing toward base, sometimes oblong-lance-shaped, 2 to 8 inches long. **Flowers** few, loosely arranged, with five oblong, deep-scarlet, two-parted petals extending from a cylinder-shaped or club-shaped base. May-June.

COMMON BLUE-EYEDGRASS, Irisette

Sisyrinchium angustifolium

This grass-like perennial which has somewhat the appearance of a tiny iris is found in large masses with its profusion of dainty, small blue flowers. Widely distributed in the State where it is found in woods, fields, and roadsides; more often in sunny locations. It may be transplanted with care.

Stem (flower stalk) mostly erect, simple, winged, stiff, 4 to 20 inches tall, generally extending above the leaves. **Leaves** all arising from base of stem, usually erect, long, grass-like, slightly broader than the stem. **Flowers** few, in clusters on end of stem, each consisting of six blue, short-tipped, petal-like segments with a yellow eye. April-May.

PINKROOT SPIGELIA, Indian Pink, Carolina Pink, Pinkroot

Spigelia marylandica

It seems incredible that this flower has so seldom found its way into the cultivated gardens of the State. Its striking flowers and attractive dark green foliage would score higher than most commonly cultivated perennials, should each be given a grade. Although it is found throughout most of the State it is more abundant in Central and North Mississippi. Found singly or in groups in creek bottoms, rich woods, and hillsides. Even though it grows well in full sun, it is more often found in shady situations. Easily transplanted. Volunteer seedlings appear readily in the spring when plants are grown under cultivation. Highly recommended for the cultivated or wild garden.

Stem erect, unbranched, 1 to 2 feet tall. **Leaves** opposite, 1½ to 4 inches long, not divided, egg-shaped to lance-shaped, often tapering to a sharp point. **Flowers** on single or clustered spikes, tube-shaped, narrow at bottom, gradually widening to a five-pointed top, scarlet outside, yellow inside. April-May.

STOKESIA, Stokes' Aster

Stokesia laevis

A native flower that has been widely cultivated in many sections of the United States. Found in sunny or shady places in moist pinelands along the Coastal Plain of South Mississippi. Reseeds readily in cultivated areas. Seeds, which may be obtained from seedsmen, often are planted in the garden. Plants may be transplanted from the woods.

Stem erect, stout, wooly, 8 inches to 2 feet tall. **Leaves** alter-

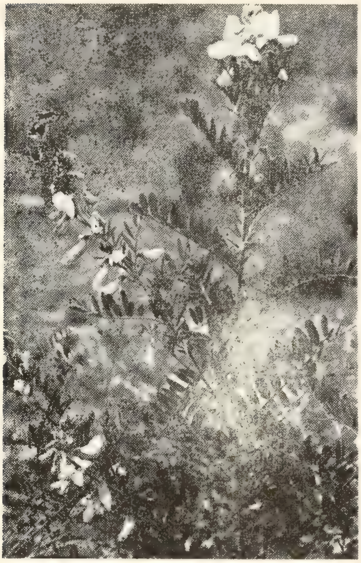

Figure 54—Virginia Tephrosia

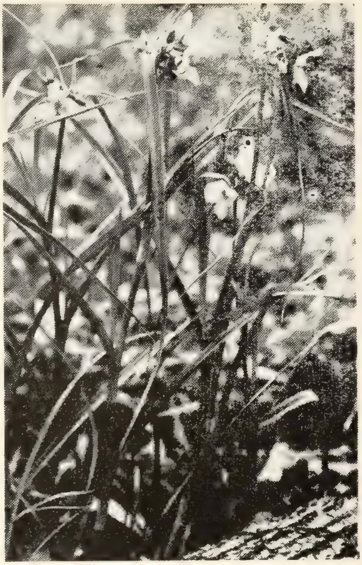

Figure 55—Spiderwort

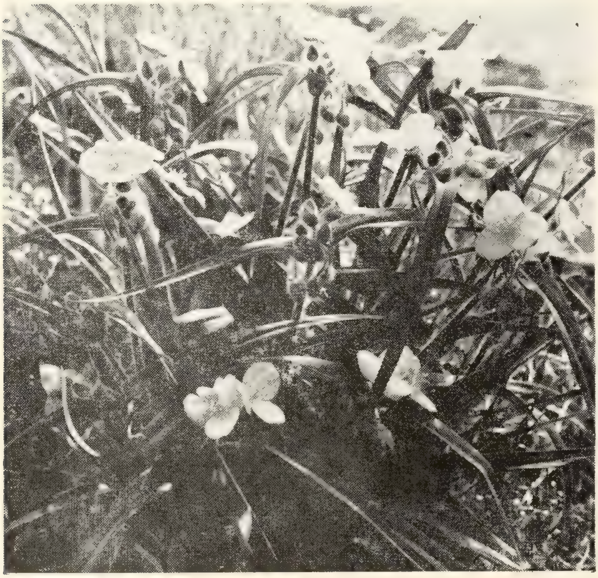

Figure 56—Hairy Spiderwort

nate, few, the lower ones more or less lance-shaped, narrowed into a petiole with an enlarged attachment point; the upper ones lance-shaped to egg-shaped, clasping the stem at attachment point. **Flower** heads produced singly on ends of main stem and branches, large, showy, purplish-blue, with numerous five-pointed, strip-shaped segments surrounding a cluster of shorter tubes, each divided into five narrow lobes at the top. June-September.

VIRGINIA TEPHROSIA, Devil's Shoestrings, Rabbitpea, Catgut

Tephrosia virginiana

The bright colored flowers of this perennial are conspicuous in the woods during the blooming season. Usually grows in open woods in dry, sandy soil in South Mississippi. Difficult to transplant.

Stem erect, soft-hairy, 1 to 2 feet tall. **Leaves** alternate, compound; leaflets 11 to 25, up to 1 inch long, short-hairy on under side, short-bristle-tipped. **Flowers** in hairy clusters on end of stem and on stalks arising from axils of upper leaves; each flower shaped like a pea blossom, the large, erect, hairy petal (standard) pale yellow, the other parts (wings and keel) pink and purplish. April-May.

HAIRY SPIDERWORT, Blue-jacket

Tradescantia hirsuticaulis

A perennial with attractive blue flowers that is a satisfactory subject for cultivation. It has a relatively long blooming season that begins in mid-spring. Usually found in sunny or partially shaded situations in fields, sandy woods, and dry banks. Rather widely distributed throughout the State. Easily transplanted.

Stem simple, or branched toward base, covered with long, white, coarse, stiff hairs. **Leaves** alternate, encircling the stem at attachment point, narrowed from base to a long point, covered with hairs. **Flowers** in clusters, few to several in number, on ends of stems or in axils of leaves, each consisting of three egg-shaped, blue petals. April-May.

SPIDERWORT

Tradescantia reflexa

A perennial which occurs frequently in most parts of the State. Woods, sandhills, barrens, bottoms, and pinelands are situations where it is found. Suitable for sunny or shady places. Relatively long blooming period. Easily transplanted.

Stem erect, smooth, slender, jointed, simple or branched, up to 3 feet tall, sometimes covered with a whitish bloom. **Leaves** alternate, encircling the stem at the attachment point, smooth with occasional hairs near the attachment point. **Flowers** in flat-topped

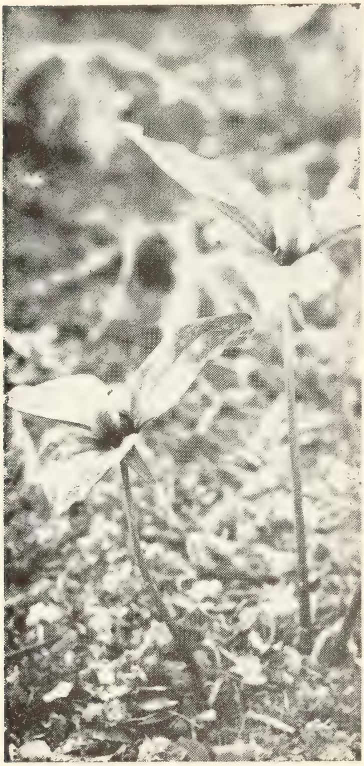

Figure 57—Prairie Trillium

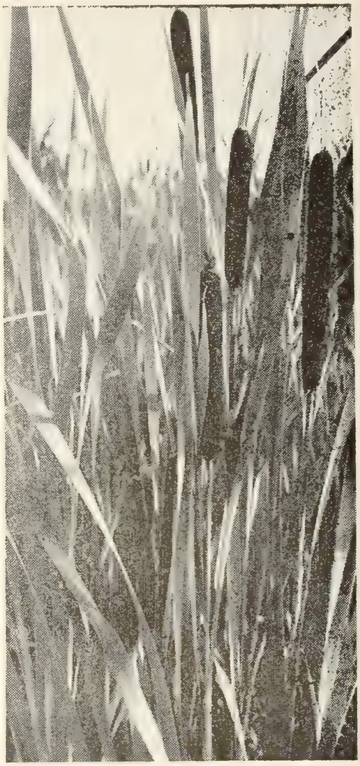

Figure 58—Common Cattail

clusters on end of stem or in axils of leaves, each consisting of three broadly egg-shaped, blue petals. March-May.

PRAIRIE TRILLIUM, Wakerobin, Birthroot, Red Trillium

Trillium recurvatum

A perennial that is more particularly attractive for its foliage than for its flowers. One of the earliest wild flowers to bloom in spring. Found in various parts of the State, usually in rich woods and banks of streams. A fine selection for shady places in the wild garden. The short, thick rootstocks may be transplanted during early spring, fall or winter.

Stem erect, smooth, 4 to 15 inches tall. **Leaves** three in number in a whorl at top of stalk, egg-shaped, lance-shaped, or oval, mottled in color, with petiole-like bases. **Flowers** produced singly on end of stem in middle of leaf whorl, the three purple, egg-shaped petals curved upward. Spring.

COMMON CATTAIL, Broadleaved Cattail

Typha latifolia

One of the common perennials throughout the State that is attractive for its fruits which form a brown club-like mass. Found in marshes, pools, ditches, and stream shores. Though it is used occasionally in garden pools, it is likely to crowd out other aquatic plants grown with it. Easily transplanted.

Stem erect, smooth, round, 4 to 8 feet tall. **Leaves** numerous, long, flat, sword-shaped, sheathing the stem at its base. **Flowers** densely crowded into long, brown spikes on ends of stems, the lighter colored flowers on top part of spike usually shedding to leave a naked stem projecting above the darker brown part. June-July.

MOTH MULLEIN

Verbascum blattaria

A perennial that should be more widely used in the cultivated garden. Suitable for sunny situations. Found in old fields and roadsides in most sections of the State. Transplant during dormant season.

Stem erect, 1 to 4 feet tall, smooth toward bottom, covered with glandular hairs toward top, simple or slightly branched. **Leaves** of lower stem oblong, petioled, doubly-toothed, those of middle and upper stem lance-shaped to egg-shaped, clasping stem at attachment point; leaves becoming smaller from base to top of plant. **Flowers** produced along upper portion of main stem and branches (if any) on short, alternately-arranged stalks arising from axils of small, leaf-like bracts; each flower consisting of a yellow or white, flat, wheel-shaped corolla, 1 to 2 inches wide, with five rounded, unequal lobes; the center of the corolla conspicuous with a cluster of purple hairs from which protrude smaller flower parts (stamens, stigma, style) giving a moth-like appearance. May-June.

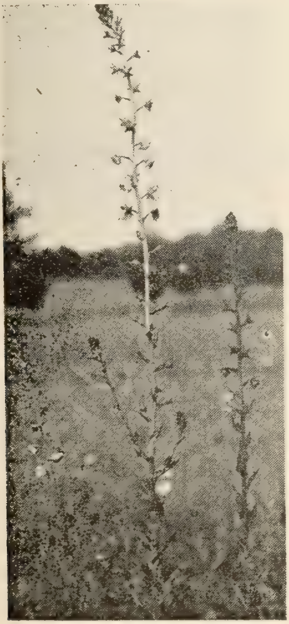

Figure 59—Moth Mullein

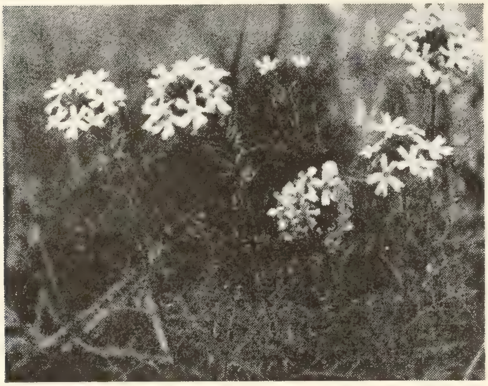

Figure 60
Dakota
Verbena

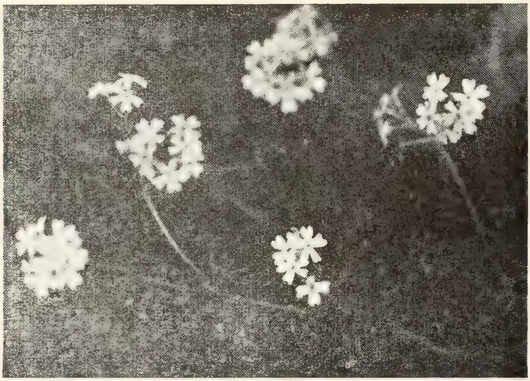

Figure 61
Moss
Verbena

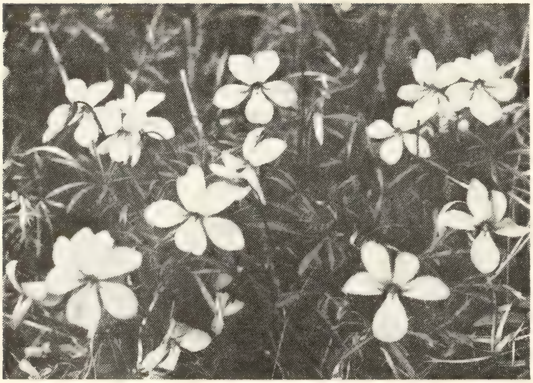

Figure 62
Birdsfoot
Violet

DAKOTA VERBENA

Verbena bipinnatifida

Although this perennial has been introduced, it appears to be native in many parts of the State. It is often found in large masses along highways, indicating that this would make a desirable plant to use in roadside plantings. Usually found in sunny locations and thrives in poor soil. Often used in the cultivated garden. Blooms profusely in early spring and continues to bloom throughout the summer. Easily transplanted.

Stem mostly erect, 4 to 15 inches tall, covered with bristly hairs. **Leaves** opposite, rather finely divided. **Flowers** in dense clusters on end of stem, each consisting of five-notched, bluish-purple or lilac petals that fuse to form a slender tube. Spring-Summer.

MOSS VERBENA

Verbena laciniata

This plant apparently has been introduced; however, it has become well established in old fields and roadsides in many parts of the State. It is particularly abundant in southern part of State. A perennial that prefers full sun. Grows well on poor soil. Easily transplanted.

Stem and branches spreading, lying flat on ground except for mostly erect flower-bearing tips, often rooting at joints, partially covered with short, stiff hairs. **Leaves** opposite, twice-divided into rather narrow, sometimes awl-shaped, spreading segments; the segments rough with short, stiff hairs, specially along veins on undersurface. **Flowers** thickly arranged on tips of stem and branches, each flower consisting of a small, slightly crooked tube, divided at the top into five spreading, notched petals; flowers rose-purple, pink, or sometimes white. April-June.

BIRDSFOOT VIOLET, Crowfoot Violet, Johnny-jump-up

Viola pedata

One of the most attractive of the small wild flowers. Of the many native violets, this one is most sought as flowers to gather in the woods or as plants to be set in the garden. Found in many parts of the State, more often in acid soil. Grows in sunny or partially shady places in open woods and dry fields. Easily transplanted.

Stem lacking, the leaves and flower stalks arising directly from the erect rootstock. **Leaves** nearly smooth, coarsely divided into three parts each of which is further divided into three to five segments that are often two- to four-toothed near the tip. **Flowers** produced singly on leafless stalks slightly taller than leaves, the upper two petals dark violet, the lower three lilac-purple, or sometimes all five lilac-purple, with a conspicuous orange spot in the center. April-May.

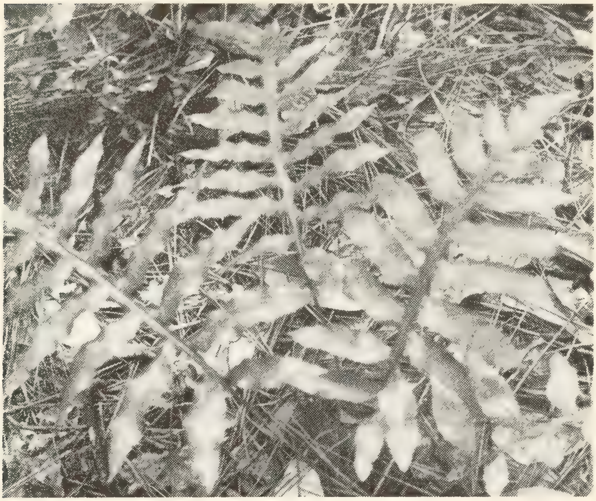

Figure 63—Netvein Chainfern

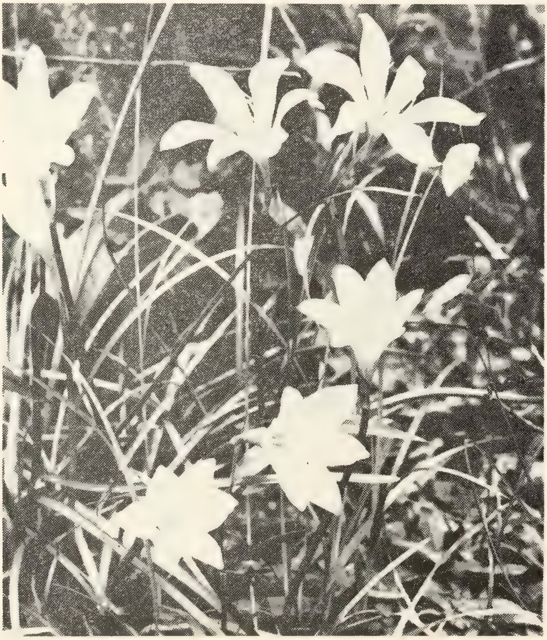

Figure 64—Atamascolily

NETVEIN CHAINFERN

Woodwardia areolata

Although most ferns are easy to grow, plants are seldom used in the home landscape. This fern is usually found in shady places in moist or wet soil. Widely distributed. Easily transplanted.

Leaves of two kinds; sterile leaves 8 to 24 inches tall, with alternate, lance-shaped, finely-toothed divisions connected by a broad wing extending along the leaf stem (rachis); fertile leaves taller, with narrower divisions almost or entirely without a connecting wing.

ATAMASCOLILY, Zephyrlily, Fairylily, Rainlily

Zephyranthes atamosco

A bulbous perennial of rare beauty that has been used to some extent in gardens of this State; however, it has not received the attention it deserves. Usually found in colonies in rich woods and low swamp areas. Although it will grow in full sun, shady places are preferable. Common in central and southern part of State. Bulbs may be transplanted any time; however, July and August when the foliage of the plant begins to turn brown is preferable.

Stem lacking except for a leafless flower stalk. **Leaves** all basal, arising directly from an underground bulb, 8 to 16 inches long, narrow, dark green, grooved, with sharp edges and a rather sharp point. **Flowers** produced singly on leafless stalks 8 to 14 inches tall, tube-shaped at base, becoming funnel-shaped toward top, with six spreading, petal-like, white or pinkish segments 2½ to 4 inches long. April-May.

TIME OF BLOOM

Early Spring

Atlantic Wildindigo
Atamascolily
Birdsfoot Violet
Blueflag Iris
Common Blue-eyedgrass
Common Mayapple
Common Yarrow
Copper Iris
Downy Phlox
Goldenclub
Indian Jack-in-the-pulpit
Keys Hymenocallis
Lady-lupine
Prairie Trillium
Small Solomonseal
Spiderwort
Sundial Lupine
Sweetwilliam Phlox
Trumpet Pitcherplant
Virginia Springbeauty
Yellow Falsegarlic

Late Spring

Atlantic Camas
Bigflower Coreopsis
Blackeyedsusan
Canada Garlic
Common Milkweed
Crow Poison
Dakota Verbena
False Dragonhead
Firepink Silene
Hairy Spiderwort
Hyssop Skullcap
Larkspur
Limestone Ruellia
Milkvetch
Moss Verbena
Moth Mullein
Oxeyedaisy
Penstemon
Pinkroot Spigelia
Showy Primrose
Smooth Phlox
Spiderwort
Virginia Tephrosia
White Milkweed
Wild Bergamot Beebalm
Willow Amsonia

Summer

Butterfly Milkweed
Cardinalflower
Common Cattail
Crimsoneye
Meadow Sundrop
Purple Echinacea
Rose-gentian
Spike Gayflower
Squarestem Rose-gentian
Stokesia
Yellow Fringeorchid

Fall

New England Aster
Savoryleaf Aster

COLOR OF FLOWERS

White

Atlantic Wildindigo
Atamascolily
Common Mayapple
Common Yarrow
Crimsoneye
Crow Poison
False Dragonhead
Keys Hymenocallis
Oxeyedaisy
Penstemon
Small Solomonseal
White Milkweed

Blue

Atlantic Camas
Blueflag Iris
Common Blue-eyedgrass
Hairy Spiderwort
Hyssop Skullcap
Larkspur
Limestone Ruellia
Spiderwort
Stokesia
Sundial Lupine
Willow Amsonia

Red

Cardinalflower
Copper Iris
Firepink Silene
Pinkroot Spigelia

Rose

Common Milkweed
Downy Phlox
Moss Verbena
Rose-gentian
Showy Primrose
Squarestem Rose-gentian
Virginia Springbeauty

Lavender

Dakota Verbena
Sweetwilliam Phlox
Wild Bergamot Beebalm

Purple

Birdsfoot Violet
Lady-lupine
New England Aster
Prairie Trillium
Purple Echinacea
Savoryleaf Aster
Spike Gayfeather

Yellow

Bigflower Coreopsis
Blackeyedsusan
Goldenclub
Meadow Sundrop
Milkvetch
Moth Mullein
Trumpet Pitcherplant
Yellow Falsegarlic
Yellow Fringeorchid

Orange

Butterfly Milkweed

HEIGHT OF PLANT

Low

(½ to 1 foot)

Atamascolily
Birdsfoot Violet
Common Blue-eyedgrass
Dakota Verbena
Goldenclub
Moss Verbena
Prairie Trillium
Virginia Springbeauty
Yellow Falsegarlic

Medium

(1 to 2½ feet)

Atlantic Camas
Bigflower Coreopsis
Blackeyedsusan
Blueflag Iris
Butterfly Milkweed
Canada Garlic
Common Mayapple
Common Yarrow
Crow Poison
Downy Phlox
Firepink Silene
Hairy Spiderwort
Hyssop Skullcap
Indian Jack-in-the-pulpit
Keys Hymenocallis
Lady-lupine
Larkspur
Western Bracken
White Milkweed
Limestone Ruellia
Meadow Sundrop
Milkvetch
Netvein Chainfern
Oxeyedaisy
Penstemon
Pinkroot Spigelia
Rose-gentian
Savoryleaf Aster
Showy Primrose
Small Solomonseal
Smooth Phlox
Spiderwort
Squarestem Rose-gentian
Stokesia
Sweetwilliam Phlox
Virginia Tephrosia
Wild Bergamot Beebalm
Yellow Fringeorchid

Tall

(2½ to 5 feet)

Atlantic Wildindigo
Cardinalflower
Cinnamon-fern
Common Cattail
Common Milkweed
Copper Iris
Crimsoneye
False Dragonhead
Moth Mullein
New England Aster
Purple Echinacea
Spike Gayfeather
Willow Amsonia

EXPOSURE

Best Adapted to Sunny Places

Atlantic Wildindigo
Bigflower Coreopsis
Blackeyedsusan
Butterfly Milkweed
Canada Garlic
Common Blue-eyedgrass
Crow Poison
Dakota Verbena
Lady-lupine
Larkspur
Meadow Sundrop
Milkvetch
Moss Verbena
Moth Mullein
Savoryleaf Aster
Showy Primrose
Sundial Lupine
Virginia Tephrosia
Western Bracken

Best Adapted to Shady Places

Cinnamon-fern
Common Mayapple
Copper Iris
Indian Jack-in-the-pulpit
Limestone Ruellia
Netvein Chainfern
Prairie Trillium
Small Solomonseal

Suitable for Sunny or Shady Places

Atlantic Camas
Atamascolily
Birdsfoot Violet
Blueflag Iris
Cardinalflower
Common Cattail
Common Milkweed
Common Yarrow
Crimsoneye
Downy Phlox
False Dragonhead
Firepink Silene
Goldenclub
Hairy Spiderwort
Hyssop Skullcap
Keys Hymenocallis
New England Aster
Oxeyedaisy
Penstemon
Pinkroot Spigelia
Purple Echinacea
Rose-gentian
Smooth Phlox
Spiderwort
Spike Gayfeather
Squarestem Rose-gentian
Stokesia
Sweetwilliam Phlox
Virginia Springbeauty
White Milkweed
Wild Bergamot Beebalm
Willow Amsonia
Yellow Falsegarlic
Yellow Fringeorchid

PLANTS FOR VARIOUS SOILS

Tolerate Dry Soils

Bigflower Coreopsis
Common Blue-eyedgrass
Common Yarrow
Dakota Verbena
Hairy Spiderwort
Lady-lupine
Larkspur
Moss Verbena
Savoryleaf Aster
Spiderwort
Spike Gayfeather
Western Bracken
Wild Bergamot Beebalm
Virginia Tephrosia

Tolerate Wet Soils

Blueflag Iris
Cinnamon-fern
Common Cattail
Copper Iris
Goldenclub
Netvein Chainfern
Spiderwort
Stokesia
Trumpet Pitcherplant
Yellow Fringeorchid

WILD FLOWERS FOR CUT FLOWER ARRANGEMENTS

Atlantic Camas
Atamascolily
Bigflower Coreopsis
Blackeyedsusan
Blueflag Iris
Cardinalflower
Common Cattail
Common Yarrow
Copper Iris
Crow Poison
Downy Phlox
False Dragonhead
Firepink Silene
Larkspur
Moth Mullein
Oxeyedaisy
Pinkroot Spigelia
Purple Echinacea
Small Solomonseal
Smooth Phlox
Spiderwort
Spike Gayflower
Stokesia
Sundial Lupine
Sweetwilliam Phlox
Wild Bergamot Beebalm
Willow Amsonia
Yellow Fringeorchid

EASILY TRANSPLANTED

Bigflower Coreopsis
Blueflag Iris
Cardinalflower
Cinnamon Fern
Common Cattail
Common Mayapple
Common Yarrow
Copper Iris
Dakota Verbena
Downy Phlox
False Dragonhead
Firepink Silene
Hairy Spiderwort
Limestone Ruellia
Moss Verbena
Netvein Chainfern
New England Aster
Oxeyedaisy
Penstemon
Pinkroot Spigelia
Prairie Trillium
Small Solomonseal
Smooth Phlox
Spiderwort
Stokesia
Sweetwilliam Phlox
Western Bracken
Wild Bergamot Beebalm
Willow Amsonia

BULBOUS PLANTS

(Divide bulbs and Transplant)

Atlantic Camas
Atamascolily
Canada Garlic
Crow Poison
Keys Hymenocallis
Yellow Falsegarlic

NOTES

BULLETIN 418 JUNE 1945

Traditional
Food Preparation Rules

By

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Traditional
Food Preparation Rules

By DOROTHY DICKINS

Department of Home Economics

In connection with the first phase of a food preparation study conducted in four small towns of Mississippi, homemakers in the 1,158 families included, were asked by white and Negro home economics teachers who were employed as interviewers, a question concerning rules taught by mother or someone else at home when learning to cook—rules such as "One can't cook string beans too much."[1] The purpose of this question was to furnish background information to use in working out record forms. Since the rules thus collected help us to understand some of the food preparation practices now prevalent, it seemed worthwhile to make a separate analysis of them.

Homemakers Reporting Food Preparation Rules

As may be noted from table 1, a little more than one-half of the white homemakers and eight-tenths of the Negro homemakers gave the interviewers one or more food preparation rules taught them. In the group not reporting rules taught were those who said they had learned from a cookbook or in a cooking class and several white homemakers who had never cooked. Families taking their meals away from home were not included in the study.

That Negro homemakers much more often gave food preparation rules than did white homemakers, may have been because the Negro homemaker had less often learned to cook in the cooking class or from a cookbook than had the white homemaker. Thirty-two percent of the white homemakers and 12 percent of the Negro homemakers had had training in a cooking class in public school or college. White homemakers could use to better advantage printed material pertaining to food preparation, for median grade completed by them was the twelfth. Median grade completed by Negro homemakers was the sixth.

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[1] The reason for using this rule as an illustration was that in a previous study it had been given by a number of homemakers.

It is not possible to state how many grades a homemaker must have completed to understand the food preparation reading material available. Much would depend on the extent to which she had continued her education since leaving school. It seems extremely unlikely that homemakers with sixth grade or less schooling could understand most of the available material on food preparation. Even if they do understand some of it, there is a question about their having the ingredients called for in recipe books, since little schooling and low income are associated.[2] Recipe books usually assume more ingredients on pantry shelves than low income families have. Under these circumstances, it is not surprising that Negro women could report more food preparation rules learned from mother.

Table 1. Proportion of homemakers giving one or more food preparation rules taught by mother or someone at home

Group	Total number of homemakers	Proportion giving one or more rules
White homemakers	698	52.3
Over 40 years	389	59.6
40 years and under	309	42.7
Negro homemakers	460	84.1
Over 40 years	196	87.2
40 years and under	264	81.8

More older women than younger women (white as well as Negro) gave one or more rules taught in learning to cook (table 1). Younger women are more likely to be recipe cooks, since cooking by recipe is of fairly recent development. About 60 percent of the white homemakers over 40 years and 43 percent 40 years and under, gave one or more food preparation rules. Eighty-seven percent of the Negro homemakers over 40 years and 82 percent 40 years and under, gave one or more food preparation rules. In other words, there was not as great difference in the proportion of older and younger women giving rules in case of Negroes as in case of whites. The younger white women had, no doubt, had more opportunity to learn food preparation in the cooking class and from books than had the younger Negro women.

---

[2] Monthly rent or rental value of owned homes of nearly two-thirds of the Negro group was $7.50 or less.

Foods Which Rules Reported Concerned

About 64 percent of the rules given by white women and 68 percent by Negro women concerned preparation of vegetables. The fact that so many vegetable rules were reported, it is thought, is not because of the use of an illustration from the vegetable group in the initial question since each homemaker was questioned about preparation rules of all food types. Without doubt the main factor is that a greater variety in vegetables than foods of other types were ordinarily prepared in parental families of homemakers of this study.

Meat, poultry, and fish preparation rules were next in importance to vegetable preparation rules for all groups (table 2), though Negro women reported relatively more than white women. Only 22 percent of the rules reported by white women and 5 percent reported by Negro women concerned preparation of other foods. That more of the rules given by white women pertained to preparation of cake and various kinds of bread was no doubt because more of the families of white women prepared these foods. Eighty-six percent of the Negro homemakers were farm-reared, the large majority in homes of nonowner families of low socioeconomic status.

Frequency in Which Rules Referring to Preparation of Particular Foods Occurred

One interesting question is the extent to which the rules given by these homemakers apply to particular foods such as turnip greens, beefsteak, and to types of foods such as vegetables and meats. According to Dr. Margaret Mead, in primitive societies each child is taught a separate piece of skill, such as how to roast the leg of a deer, rather than general principles that apply to types of food, i. e., all meats.[3]

About three-fourths of the vegetable rules reported by Negro women and two-thirds reported by white women, pertained to specific vegetables. In the case of meat, only about one-third of the rules reported by both groups concerned preparation of specific meats or cuts of meat. The fact that meat and pork are synonymous terms to many rural people in Mississippi might be interpreted to mean that some of the rules applying to preparation of meat really applied to preparation of pork. However, bread and cornbread are likewise synonymous terms to many rural people in the State, the rules given by homemakers in all cases concerned preparation of specific breads; i. e., cornbread, biscuits, rolls. The facts that homemakers of this study

Table 2. Type of foods for which rules* for preparation were reported

Food type	Percentage of rules reported by			
	White homemakers		Negro homemakers	
	over 40 years	40 years and under	over 40 years	40 years and under
Vegetables	62.1	66.2	64.1	71.4
Meats, poultry, fish	15.9	11.4	31.9	23.0
Cakes	9.5	10.1	.5	.5
Breads	6.0	4.4	.9	—
Food preservation	2.6	1.9	.9	—
All other specified food or food types	1.3	3.5	1.1	3.8
"Food" or "all foods"	2.6	2.5	.6	1.3
Total	100.0	100.0	100.0	100.0
Number of rules	464	317	348	370

*There were in addition 44 rules not applying to food preparation inadvertently reported. They were by **white homemakers:** (1) food health rules, 6; (2) menu planning rules, 12; and (3) cleaning rules, 2; by **Negro homemakers:** (1) food health rules, 20; (2) menu planning rules, 4. These were excluded from this tabulation.

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[3] Need for Teaching Anthropology in Normal Schools and Colleges, Margaret Mead, School and Society, Vol. 26, pp. 466-68, Oct. 1927.

resided in towns where a variety of meat or cuts of meat could be secured, and that a variety appeared on records of menus served which were submitted by these women in connection with another part of this study, would suggest that homemakers in reporting rules referred to meat in general, rather than pork, when they mentioned meat. All this can be interpreted to mean that not only are more vegetable rules passed down from mothers to daughters, but also that rules passed down are more likely to be specific, i. e., apply to particular vegetables.

The frequency of negative rules was studied as one possible explanation for relatively more rules applying to preparation of all vegetables being reported by Negro women than by white women. It was thought that negative points might be aimed at a tendency to overgeneralize or at an absence of a body of practice such as must have been true of field Negroes when they first entered the house as house servants, or aimed by white employers at practices which Negroes followed in their own homes and carried over into the kitchens of white employers.

Fourteen vegetable preparation rules reported by Negroes and 42 by whites were negative rules; i. e., "Do not peel potatoes as you lose vitamins," "Never cook cabbage long," "Don't add soda to vegetables." This means that the tendency of the Negro to generalize vegetable rules cannot be accounted for by negative rules which were more common in the white group.

Eleven percent of all the preparation rules reported by white women and 3 percent of all the rules reported by Negro women were negative rules. Three-fourths of the negative rules reported by white women and two-thirds by Negro women represent the more modern attitudes and beliefs. This is a much higher proportion than in case of positive rules representing such attitudes and beliefs. These vegetable rules are probably associated with conscious cultural change such as is involved in modern home economics education.

That more vegetable preparation rules reported by white homemakers pertained to preparation of specific vegetables may be due to the fact that the variety of vegetables used by white families was greater. The following vegetables were mentioned in rules given by white women but not by Negro women: spinach, eggplant, carrots, mustard, English peas, butter beans, canned string beans. Irish potatoes, sweetpotatoes, turnip greens, turnips, cabbage, string beans, and collards were, however, the vegetables most often mentioned in rules given by both groups.

There was apparently a trend away from rules mentioning particular foods to rules of more general application. In 66 percent of the rules reported by white women over 40 years of age, and 61 percent by Negro women over 40 years of age, a particular food was named. Fifty-six percent of the rules reported by younger white women and 52 percent by younger Negro women referred to a particular food.

The Problem of Classifying Preparation Rules

One possible way of classifying preparation rules tried out was by source, i. e., (1) scientific rules, (2) out-of-date written tradition, (3) oral tradition (table 3). Thus, as will be noted, it was not possible with the information available to classify by source the majority of rules reported.

"Scientific rules" were preparation rules in agreement with recommendations of modern nutrition and/or food specialists. "Out-of-date written tradition" included preparation rules found in four of the popular older cookbooks, now outdated because of increased knowledge of nutrition or better technical methods developed by food specialists or changes in processing.[4] It is likely that more rules would have been classified in this category had more old cookbooks been examined.

One characteristic of rules whose source is oral tradition is reasons attached to rules so as to make them stick in the memory. However, in this study, as great a tendency was found to attach reasons to the rules found in the old cookbooks as in those whose source was not ascertained. But there was a difference in the kind of reasons attached. In the group of rules whose source was not known, a number of reasons for rules inferring that unwholesome qualities exist in the food at all times or at certain periods (at time of first harvest, when there has been a lot of rain, when there has been sickness) were given. Such reasons did not accompany rules found in old cookbooks. Therefore, rules listed as oral tradition are limited here to rules whose source was not determined and which were accompanied with reasons implying unwholesome qualities in food.

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[4] (a) Common Sense in the Household. A manual of Practical Housewifery, by Marion Harland, Scribner, Armstrong & Co., New York, 1876.

(b) Miss Parloa's New Cook Book. A Guide to Marketing and Cooking, by Maria Parloa, Estes and Lauriat, Boston, 1886.

(c) Mrs. Lincoln's Boston Cook Book. What to Do and What Not to Do in Cooking, by Mary J. Lincoln, Roberts Bro., Boston, 1898.

(d) White House Cook Book. A Comprehensive Encyclopedia of Information for the Home, by Hugo Zieman and Mrs. F. L. Gillette, Soalfield Pub. Co., New York, 1907.

The rules thus classified as oral tradition may represent a Negro folk contribution. The fact that Negroes reported about six times more of them than did whites would support this hypothesis (table 3). All except six of the rules in this category were reported in connection with vegetable preparation. Among these reasons were: "to

Table 3. Food preparation rules reported by older and younger white and Negro homemakers classified by source

Item	White homemakers		Negro homemakers	
	over 40 years	40 years and under	over 40 years	40 years and under
	Percent	Percent	Percent	percent
Scientific rules (those recommended by modern nutrition or food specialists)	57	63	24	36
Written tradition (out-of-date, found in old cookbooks)	37	31	37*	29*
Oral tradition (rules accompanied with reasons which infer unwholesome qualities exist in food)	6	6	39	35
Number rules in 3 groups above	175	138	138	159
Number rules reported in all	464	317	348	370

*Thirty-three of these rules reported by women over 40 years and 31 by women 40 years and under were "add vinegar to tender" rules.

keep from making sick," "to remove the poison substance," "to draw out the poison," "to draw out the sap," "to make fit to eat," "to make healthy," "to soak out the fever," "to draw out the heat," "to kill germs." The three most common were: "to keep from making sick," "to remove poison," and "to draw out sap." The sap apparently affected the vegetable adversely by introducing a poison into the system that, even if it did not cause sickness, was not healthful.

Eighty-three percent of the 718 rules given by Negro homemakers and 26 percent of the 781 by white homemakers contained a reason for the rule. Sixty-six percent of the "scientific" rules reported by Negroes and 18 percent by whites had reasons attached. In other words, even in the case of recommendations of food and nutrition specialists there was an attempt to commend the practice on the basis of a sound practical sense. This may mean that in passing on scientific material and especially to the Negro, "the home economics teacher says so" is not a sufficient reason. A practical reason should be given with every rule.

According to the classification of food preparation rules by source (table 3), rules taught white women were either those accepted by modern food and nutrition specialists or out-of-date written tradition. Negro women seemed to have been taught rules in about equal number in all three classes. However, 64 of the 98 rules classified as written tradition reported by Negro women referred to soaking meat in vinegar to tender, a rule found in only one cookbook examined.[5] The rules reported by white homemakers classified as "written tradition" were quite varied.

From these data it would seem that there was a tendency for younger white and Negro women to report more often recommendations of modern nutrition and food specialists, for older white women to report more frequently out-of-date written tradition, and for older Negro women to report oral tradition accompanied with reasons inferring that unwholesome qualities exist in food.

An examination of the rules reported by the 1,158 homemakers of this study shows the difficulty of distinguishing between written and oral tradition, since in passing on such rules changes are made in wording and often in meaning.

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[5] Zieman and Gillette, op. cit., p. 541.

In connection with changes in wording, it might here be mentioned that white homemakers reported what seemed to be 357 different preparation rules; Negro homemakers 326. But when a classified list was compiled of all rules reported, and each rule counted as a distinct rule if it did not contain the exact wording of another rule, the number reported by white women was 579 and by Negro women 533.[6]

Classification of Food Preparation Rules

For the purpose of this study, the rules reported were classified into five groups: (1) preparation rules which are in accord with practices now recommended by nutrition and food specialists, (2) preparation rules which are in accord with directions found in old cookbooks examined, but are now out-of-date because of increased knowledge of nutrition or better technical methods or changes in processing, (3) preparation rules which are in accord with observation but not found in old cookbooks examined which are now out-of-date because of increased knowledge of nutrition or better technical methods or changes in processing, (4) preparation rules seeming to have little or no basis, (5) preparation rules of the recipe type.

As may be noted from table 4, the majority of rules given by all four groups fell in the "seeming to have but little or no basis" classification. They are not in accord with practices now recommended, nor are they of the recipe type or in accord with observation. They were not found in the old cookbooks examined. Examples of rules classified in this category are "parboil new Irish potatoes," "drop a nail in the pot of tough meats to make cook quickly," "wash cabbage in soda water to kill poison," "tip around while baking cake to keep cake from falling."

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[6] This list can be secured from the Home Economics Department of the Mississippi Experiment Station.

Rules in accordance with practices now recommended by specialists were next in importance with white homemakers (table 4). These rules were of two types: (1) those in accord with recommendations of nutrition specialists (nutrition recommendations), (2) those in accord with recommendations of food specialists (technical recommendations). Examples of the former type are "do not drain liquid from vegetables," "cook meat at low temperature and in a small amount of water," "always boil meat first before adding vegetables." Examples of the latter type are "always warm milk before adding to potatoes for mashing —makes them fluffier," "always cook cornbread and biscuit quickly," "a straw will come out clean when cake is done." When rules were both nutritional and technical, as was the one concerning cooking of meat, the rule was classified by the first or main reason.

Rules in accord with observation but not found in cookbooks examined, now outdated, were of second importance to Negroes (table 4). These rules were also of two types: (1) those outdated because of increased knowledge of nutrition, (2) those outdated because of better technical methods developed by food specialists or changes in processing. Examples of rules in accord with observations now outdated because of increased knowledge of nutrition are "always parboil turnip greens to make less strong," "put soda in collards to tender." Examples of outdating because of changes in processing or development of better technical methods are "to keep fresh pork, fry and pack in fat in sterilized jars. Store in a cool place. This is good for a month," "boil meat until tender, then bake."

The principal difference in rules classified in groups II and III was that rules classified in group II appeared in the cookbooks examined. Rules in group III were not found in cookbooks examined, but were based on sound observation. Rules in both groups were outdated. Examples of rules classified in group II outdated because of increased knowledge of nutrition include "pour first water off of cabbage and add more," "always put old potatoes on in cold water." Examples of rules in group II outdated because of development of better technical methods or changes in processing include "always beat cake batter thoroughly," "parboil salt meat to remove salt before frying."

Table 4. Classification of food preparation rules taught white and Negro homemakers

Item	Reported by white women		Reported by Negro women	
	Over 40 years	40 years and under	Over 40 years	40 years and under
	Percent	Percent	Percent	Percent
Preparation rules:				
(1) In accord with practices now recommended	21.6	27.4	9.2	16.0
(a) By nutrition specialists (nutrition recommendations)	9.5	17.0	6.3	10.0
(b) By food specialists (technical recommendations)	12.1	10.4	2.9	6.0
(2) In accord with directions found in old cookbooks examined, now outdated	14.0	13.6	15.0	12.3
(a) Because of increased knowledge of nutrition	6.3	5.7	2.9	2.4
(b) Because of better technical methods developed by food specialists or changes in processing	7.7	7.9	12.1	9.9
(3) In accord with observations but not found in old cookbooks examined, now outdated	9.9	6.7	18.1	17.9
(a) Because of increased knowledge of nutrition	5.8	5.4	16.4	17.9
(b) Because of better technical methods developed by food specialists or changes in processing	4.1	1.3	1.7	0
(4) Seeming to have but little or no basis	49.8	49.1	49.4	46.2
(5) Of the recipe type	4.7	3.2	8.3	7.6
Total	100.0	100.0	100.0	100.0
Number of rules	464	317	348	370

Rules of the recipe type were of less importance than those classified in the other four categories (table 4). Examples of such rules include "always use eggs in making cornbread," "use the 1-2-3-4 rule in making cakes," "put a little sugar in all vegetables. Tastes better."

In several instances, as will be noted in later discussions, rules concerning use of specific ingredients or objects in preparation have been classified in more than one group. Thus, use-of-soda-to-tender-vegetables rules were classified in group III, but rules such as "wash cabbage in soda water to kill poison," "add a little soda to vegetables to make taste better" were classified in group IV. Rules concerning use of nails in cooking meat and poultry were classified either in group I or group IV. For example, the rule "put a nail in roast to cook quicker" was placed in group I, but "put a nail in the pot with roast to cook quicker," "put nails in roasts to tender," "put nails in pot of cooking roast to tender," were placed in group IV.

VEGETABLE PREPARATION RULES

All groups more often reported vegetable preparation rules seeming to have but little or no basis, but relatively more of those given by white women were in this group than by Negro women. White women also gave relatively more vegetable preparation rules in accord with practices now recommended and more rules in accord with directions found in old cookbooks examined, but now outdated (table 5). The type of oral tradition which is originally grounded in cookbooks may prove very stubborn and difficult to penetrate with increased knowledge of nutrition or better technical methods worked out by scientists as the earlier tradition had itself certain sanction.

Negro women reported relatively three times more vegetable preparation rules in accord with observation but not found in old cookbooks examined and now out-of-date than did white women. This supports a previous statement that "practical" rules seem to appeal especially to Negro women. To break down such practices as adding a pinch of soda may, therefore, mean finding a less objectionable way to tenderize or cook quickly.

The principal difference in vegetable preparation rules given by older and younger women was in the proportion

Table 5. Classification of vegetable preparation rules taught white and Negro homemakers

Item	Reported by white women		Reported by Negro women	
	Over 40 years	40 years and under	Over 40 years	40 years and under
	Percent	Percent	Percent	Percent
Preparation rules:				
(1) In accord with practices now recommended	14.9	22.4	9.0	12.5
(a) By nutrition specialists (nutrition recommendations)	10.8	19.0	6.3	9.8
(b) By food specialists (technical recommendations)	4.1	3.4	2.7	2.7
(2) In accord with directions found in old cookbooks, examined, now outdated	12.8	9.5	3.6	3.0
(a) Because of increased knowledge of nutrition	10.1	7.6	3.6	3.0
(b) Because of better technical methods developed by food specialists or changes in processing	2.7	1.9	0	0
(3) In accord with observations but not found in old cookbooks examined, now outdated*	9.4	8.1	26.0	25.4
(a) Because of increased knowledge of nutrition	9.4	8.1	26.0	25.4
(4) Seeming to have little or no basis	61.5	59.6	52.0	50.0
(5) Of the recipe type	1.4	1.4	9.4	9.1
Total	100.0	100.0	100.0	100.0
Number of rules	288	210	223	264

*No rule classified as outdated because of better technical methods developed by food specialists or changes in processing.

of rules reported in agreement with recommendations of modern nutrition specialists. About 11 percent of the vegetable rules reported by older white women were classified in this group, while 19 percent, or nearly one-fifth reported by younger white women were placed in this group (table 5). This would be expected, since there had been less change in recommendations in the shorter period during which the younger group had kept house.

Vegetable Preparation Rules in Accord With Practices Now Recommended

Vegetable preparation rules in accord with practices now recommended, given most often by both white and Negro women, included rules concerning: (1) cooking time, 20 by whites and 8 by Negroes; (2) amount of water in which vegetables started, 7 by whites and 10 by Negroes; (3) temperature of water in which vegetable started, 14 by whites and 5 by Negroes; and (4) techniques for preparation of particular vegetables, 7 by whites and 10 by Negroes. Rules in the first three groups were practices now recommended by nutrition specialists, while those in the fourth group were practices recommended by food specialists (technical recommendations).

Twelve of the 20 time-of-cooking rules given by white women and 2 of the 8 given by Negro women referred to cooking cabbage a short time: "Cook cabbage a short time," "don't overcook cabbage." Only two other vegetables were mentioned in time of cooking rules—string beans by a Negro woman and Irish potatoes by a white woman. Four of those given by white and four by Negro women referred to time for cooking all vegetables; i. e., "Cook vegetables until tender," "vegetables cooked quickly taste better," "never overcook vegetables." Three rules given by white women and one by a Negro woman concerned boiling salt pork before adding the vegetable. These four rules were classified as time-of-cooking rules, since one reason for long cooking is starting the vegetable with raw salt pork and cooking until the meat is very tender. One means of reducing cooking time is to have the pork nearly cooked at the time of adding the vegetable.

Among the amount-of-water rules classified in group I, given by white women, were: "Never put water in spinach," "cook string beans in very little water," "don't use much water in fixing vegetables." Among those given by Negro women were: "The less water one uses in vegetables the better taste they have," "cook squash in a small amount of water and grease," "cook string beans in just enough water to get tender."

Seven of the temperature-of-water rules reported by white women and two by Negro women mentioned particular vegetables, such as potatoes, turnip greens, cabbage: "Put turnip geens on in boiling water," "put beans and cabbage on in hot water," "start turnip greens in hot water."

Included in the group of techniques in preparing particular vegetables reported by the women of this study which are in accord with recommendations of food specialists were: "Cut corn at tip and scrape to keep from getting in hulls," "always leave some stems on beets until they are cooked," "dry potatoes before frying."

Among other important rules classified in group I and reported by white homemakers were 11 rules concerning cooking with peeling on or preparing vegetables so that there was as little waste as possible from peeling. No rule of this type was reported by Negro homemakers. Among the peeling rules were: "Always cook old potatoes with skins on," "peel potatoes as thin as possible to save food value," "always cook potatoes with jackets on," "do not peel potatoes, as lose vitamins," "boil sweetpotatoes with skins on," "always leave skins on vegetables when possible," "never peel carrots but scrape them."

Other vegetable preparation rules classified in group I were quite varied and included rules concerning nonuse of soda, tests of doneness, not draining liquid, time of harvest, care between harvesting and cooking, preparation for cooking, removing scorched taste, reducing ill effects of odor, and cooking with lid.

Vegetable Preparation Rules in Accord With Directions Found in Old Cookbooks Examined, Now Outdated

Since older cookbooks are written tradition (research in the nutritional and technical aspects of food preparation are of fairly recent development), most of this section will be devoted to calling attention to some of the similarities found in vegetable preparation rules reported by homemakers and found in cookbooks examined.

The most common type of outmoded vegetable preparation rule reported by homemakers which appeared in cookbooks examined was one concerning soaking fresh vegetables in water before cooking. Twenty of the 57 vegetable preparation rules reported by white women and classified in group II, and 8 of the 16 reported by Negro women and also classified in this group were soaking rules. Soaking vegetables is not now recommended, since water-soluble vitamins go into the soaking water which is discarded when the vegetable is put on to cook[7].

Among statements concerning soaking of vegetables found in cookbooks examined were: "Lay when peeled in cold water for some time before cooking"[8] (one of eight rules given by Harland applicable to preparation and cooking all vegetables), "most vegetables when peeled are better flavored when laid in cold water a short time before cooking,"[9] "remove the outside leaves of cabbage, cut into quarters, cut off the tough center, and soak in cold salted water one-half hour."[10] These statements closely paralleled several given by women of this study, two of which were "always prepare vegetables and put in water until ready to cook," and "always quarter cabbage and let set in water an hour before cooking."

The outdated vegetable preparation rule of next importance reported by homemakers of this study, found in cookbooks examined, was a rule concerning parboiling two of the strong flavored vegetables—cabbage and onions. Parboiling cabbage and onions is not now recommended by nutrition specialists, since valuable minerals and vitamins are lost by such procedure. Eight parboiling rules of this type were given by Negro women, four by white women. Among them were: "Pour first water from cabbage and add more," "always parboil cabbage," "parboil onions to improve flavor."

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[7] According to recent investigations in nutrition, the loss of vitamins during soaking is small. Even though the loss is small, the practice is useless unless perhaps in case of wilted vegetables. How much cooking time is reduced and flavor improved by soaking wilted vegetables is not known. However, it is known that soaking wilted vegetables does not restore the vitamin C lost in wilting.

[8] Harland, op. cit., p. 210.

[9] Zieman and Gillette, op. cit., p. 182.

[10] Lincoln, op. cit., p. 302.

Similar statements concerning parboiling cabbage and onions found in old cookbooks were: "Always boil cabbage in two waters,"[11] "cut off tops and tails of onions and skin them. Lay in cold water half an hour, then put into a sauce pan with enough boiling water to cover them. Cook fifteen minutes and drain off the water. Re-cover them with more from the boiling teakettle. Boil until a straw will pierce them, drain and put into a dish with pepper, salt, and plenty of butter."[12]

Other rules which are now outdated because of increased knowledge of nutrition reported by a number of white homemakers and corresponding to those found in old cookbooks examined, pertained to time of cooking and amount of water. Among these were: "Cook vegetables until **thoroughly** done," "boil string beans for two hours," "boil string beans for three hours," "start string beans with water just enough to cover," "start cabbage in a great deal of water." These same rules were found in one or more of the old cookbooks examined, though 2 and 3 hours were given in these books as maximum cooking time for cooking string beans rather than the cooking time.[13]

It would seem that old cookbooks may be in part responsible for preserving the outmoded practice of long cooking, especially of string beans. In food preparation studies now being made by the writer in which records of cooking time for various vegetables have been secured, string beans is among the vegetables cooked for the longest time.

Time-of-adding-salt rules, stating that salt should be added at the end of cooking process, were reported by eight white homemakers. Since food specialists recommend that salt be added at the beginning of the cooking process, as adding at first helps retain color of green vegetables and improves flavor, these rules were classified as rules outdated because of better technical developments (table 5). (Nutritionists have not shown that adding salt at first increases cooking losses.) Among statements appearing in cookbooks examined pertaining to addition of salt at end of cooking process, were: "The salt should never be put in peas before they are tender unless very young, as it tends to harden them,"[14] "after string beans have boiled until tender and the water nearly boiled out, add pepper and salt."[15] These statements corresponded to: "Never salt peas (dry or fresh) until tender" and "never salt string beans until they're done" reported by white homemakers of this study.

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[11] Harland, op. cit., p. 219.
[12] Ibid, p. 228.
[13] Parloa, op. cit., p. 237, and Lincoln, op. cit., p. 298.

Other vegetable preparation rules in accord with directions found in old cookbooks examined, given by white and Negro women, that are now outdated include rules pertaining to draining vegetables, concerning temperature of water in which to start Irish potatoes, and danger of allowing food to stand in tin cans.

Vegetable Preparation Rules in Accord With Observation but Not Found in Old Cookbooks Examined, Now Outdated

All of the 169 rules classified in this category except 6—3 given by white women, and 3 by Negro women—were rules for parboiling to reduce bitter or strong taste or musty flavor or to keep from turning dark, and for the use of soda to cook quicker, to tender, and/or to retain color. All vegetable preparation rules classified in group III were in accord with observation but outdated because of increased knowledge of nutrition. None of these rules were found in the old cookbooks examined.

White homemakers reported 27 parboiling rules of the type described above. Negro homemakers reported 10. Among these given by the white group were seven concerning parboiling dried peas and beans, seven concerning parboiling of spinach, seven concerning parboiling of turnip greens, two concerning parboiling mustard greens, and one concerning parboiling of collards, to make less strong or to remove musty taste or to remove bitter taste. Three rules were given for parboiling sweetpotatoes to keep them from turning dark.

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[14] Zieman & Gillette, op. cit., p. 201.
[15] Ibid, p. 199.

Negroes mentioned parboiling of turnip greens in five rules, dried peas in three, and collards in one. Parboiling sweetpotatoes to keep them from turning dark was mentioned by only one Negro woman.

Fourteen use-of-soda rules reported by white women and 112 reported by Negro women were classified in group III. These included addition of soda to vegetables during cooking, or washing in soda water in order to cook quicker, to tender, or to "keep green color." While these rules are based on sound observation, they fail to obtain an objective which modern nutrition regards as more important; i. e., preservation of vitamins.

In only three instances was the addition of soda to vegetables in cooking mentioned in the cookbooks examined. It was mentioned once by Lincoln in connection with use of soda for keeping color of vegetables. "This," she declared, "was a practice by many, but unwisely so."[16] The other two occasions were in connection with preparation of Boston baked beans—a vegetable dish not mentioned in any rule submitted, a dish not ordinarily prepared by the Mississippi housewife.[17] It is possible, however, that the rules on the use of soda in tendering vegetables came from its use in preparation of Boston beans and that rules for parboiling turnip greens, spinach, dry peas, mustard greens, collards to make taste better, came from rules pertaining to parboiling cabbage and onions. There are no means of checking on this connection. Then, too, as has been suggested before, perhaps some of these rules would have been found had more cookbooks been examined.

Of the 112 use-of-soda rules reported by Negro women classified in group III, 87 concerned addition of "a little soda" or "a pinch of soda" or "soda" to vegetables or to a specific vegetable to tender or cook quicker. Twenty-three were rules for washing in soda water to tender. Washing in soda water might be less objectionable than adding soda during cooking, if less soda was left on the vegetable after washing than added during cooking. The other two were "add a little pinch of soda to vegetable to keep color," and "add soda to turnip greens to tender and keep color." In 66 of the 112 soda rules the word "vegetable" was used; in 3, the words "tough vegetables;" in 4, the words "green or green leafy;" and in 39, particular vegetables, i. e., turnip greens, cabbage, collards, and string beans.

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[16] Lincoln, op. cit. p. 291. Recent investigations have demonstrated that a small amount of soda can be used in cooking vegetables without loss of vitamin B1 provided cooking time is short. However, on the basis of cooking records secured in connection with another phase of this investigation, it seems unlikely that those using soda will control either cooking time or amount of soda to the extent necessary to prevent loss.

[17] Ibid, p. 250, and Zieman & Gillette, op. cit., p. 142.

Thirteen of the 14 use-of-soda rules reported by white women classified in group III pertained to addition of soda to vegetables in order to tender or cook quicker. One rule concerned addition of soda to "keep vegetable green." No rule was given for washing in soda water to tender. Five rules mentioned particular vegetables such as turnip greens, cabbage, and dry peas and beans.[18]

Vegetable Preparation Rules Seeming to Have But Little or No Basis

The most frequent type of rule reported by both white and Negro women classified in this group (group IV) was a rule referring to **preparation of new vegetables.** (By a new vegetable is meant the first "mess" or "messes" of vegetables harvested.) One hundred and twenty-nine such rules were given by white women, 72 by Negro women. Eighty-six percent of the preparation-of-the-new-vegetable rules by whites and 92 percent by Negroes referred to preparation of new Irish potatoes.

All preparation-of-new-Irish-potato rules, except two given by white homemakers and five given by Negro homemakers, pertained to parboiling new Irish potatoes, though one of the rules reported by Negroes and two by whites would have this parboiling done in soda water. The rule to parboil new Irish potatoes no doubt resulted from the fact that in the past there have been some persons who have become ill from eating them. Since new potatoes contain more solanin, a substance capable of causing illness if taken in large enough quantities, than do old potatoes, it has been generally assumed that it was the solanin that caused the illness. However, investigators have shown the amount of solanin contained in new potatoes, in amounts ordinarily eaten, is insufficient to produce the symptoms described. Some potato poisonings have been traced to eating potatoes which were green due to exposure to the sun, but most of the cases of illness reported are said to be due to bacterial infection. New potatoes, because of their higher content of water, decompose much more readily than old ones. Potatoes cooked one day and kept until the next without refrigeration and served unheated, are especially good media for bacteria. There would seem to be little if any basis for parboiling new Irish potatoes.[19]

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[18] The dry peas and beans ordinarily used are dry cowpeas and dry butter (lima) beans.

A number of parboiling-new-Irish-potato rules, especially those reported by Negro women, gave reasons for parboiling new potatoes, such as "to make healthy," "remove poison," "get sap out," "keep from making sick." Most of the rules given called for pouring off first water and adding more water to complete cooking, but in several, parboiling a couple of times was mentioned, and in a few, parboiling three times.

The seven other rules (five by Negro homemakers and two by white homemakers) for preparation of new Irish potatoes called for soaking in cold water after peeling "to get sap out," "remove poison substance," or "make healthier."

Twenty-four rules were given referring to new vegetables other than new potatoes (18 by white women, 6 by Negro women). Seven white homemakers gave the rule "always parboil all new vegetables." No Negro woman gave this rule. Four white and four Negro homemakers gave the rule "always parboil new cabbage." In addition, one Negro homemaker gave the following rule: "Stand new cabbage in cold water; they won't make you sick." Three white women and one Negro woman gave the rule "always parboil new string beans." In one of the rules given by a white woman, it was stated to do this three times. The other five rules concerning new vegetables, all given by white homemakers, concerned parboiling new butter beans, new squash and new peas.

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[19] Read following references:

Food Control—Its Public Health Aspects, James Houston Shrader, John Wiley & Sons, New York, 1939, pp. 414-15.

Food Poisoning, A Dieudonne, B. B. Treat & Co., New York, 1909, pp. 91-98.

Food-Borne Infections and Intoxications, F. W. Tanner, Twin City Printing Co., Champaign, Ill., 1933, pp. 115-19.

Beliefs in the evilness of first vegetables seem unusually strong in this group of vegetable preparation rules. From this it would seem that teachers of Home Economics in the area might well include such traditional beliefs with attempts to change food preparation practices such as parboiling and soaking.

In addition to the parboiling rules for **new** vegetables just discussed, there were 37 other parboiling rules reported by Negro homemakers and 20 by white homemakers classified in group IV. Twenty-three of these rules by Negroes and five by whites concerned need for parboiling white potatoes. In most of the rules the purpose of this parboiling was not stated. One white woman gave "to make better." Reasons given by Negro women giving reasons were: "to prevent poisoning," "to keep from making sick," "to remove poisonings," "to get rid of poisons." Qualities given the new potato by many women may have been attributed to all potatoes by some women.

Nine rules concerning parboiling strong flavored vegetables such as cabbage and turnip greens, were given by Negro women, four by white women. These rules differed from those classified in groups II and III in that the aim of parboiling was not to reduce strong flavor and make taste better, but "to keep from being sick," "to remove poison," "let sap out," "take out fever"—an aim similar to that often expressed in preparation of new vegetables.

In addition to the parboiling rules just discussed, there were 16 other parboiling rules reported, among which were:

"Parboil all vegetables" (reported by two white and two Negro women), "parboil all fresh vegetables" (reported by 4 white women), and "parboil string beans and butter beans" (reported by 4 white women and 2 Negro women). These rules, like the rules for parboiling Irish potatoes, may be a transfer from rules concerning need of parboiling all new vegetables, new butter beans, or new string beans.

Rules in group IV are of two general types: (1) Those which seem to have aims usual to general cookery—a palatable product, i. e., good taste, tenderness, and (2) those in which preparation is to be carried on in a specific manner, as otherwise a discomfort will follow from eating the food. Seventy percent of the vegetable rules classified in group IV reported by Negroes and 54 percent reported by whites seem to be of this second type. The remainder in the group seem to be of the first type.

Other types of rules implying or stating discomfort lodged in food, in addition to rules concerning preparation of new vegetables and parboiling just discussed, were use-of-soda rules, rules pertaining to harvesting, rules concerning soaking before cooking, and a miscellaneous group[20] including, among others, use of a "lot of fat to keep from making sick," "washing in bar soap to draw out fever," and "cooking all water out," i. e., the idea of never leaving water in vegetables or a particular vegetable, as cooking water was not good for one. Is it possible that this could be a misinterpretation of the home economics rule "cook vegetables in a little water"?

Forty-three rules reported (42 by Negro women and 1 by a white woman) concerned use of soda in cooking, or soaking in soda water "to keep from forming gas," "to keep from getting diarrhea and other diseases," "to remove poisons," "to keep from being sick," "to kill poisons," "to get fever out," "to make fit to eat," "to prevent illness." It is possible that use of soda was associated in the minds of some of the Negro homemakers with relieving discomfort and that since discomfort was lodged in the vegetable, then adding soda would help the situation.

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[20] Included in this group were two rules for long cooking reported by Negro women. Most of the long cooking of vegetable rules implied long cooking to improve taste. These two stated long cooking "to make healthier" and "get rid of poison."

Nine harvest rules were reported by Negro women, and one by a white woman, implying that there was a particular time of day or season that vegetables should not be harvested. These rules included: "Do not let the sun shine on vegetables the day you cook them." (This was reported by three Negro women and one white woman.) Other harvest rules reported were: "Never eat sweetpotatoes before frost falls," "never eat collard greens until frost falls on them." These potatoes and greens were said "not to be good for one." The fact that sweetpotatoes and collards have a lower sugar content in summer before they are mature possibly explains why they do not taste as good. The fact that they do not taste as good then may have led to the rule that they are not good for one.

Five of the rules reported by Negro women and four reported by white women pertained to value of soaking, or adding water to make the vegetable more healthful to eat. Among these were: "Let string beans stand in water for an hour before cooking—healthier," "soak cucumbers in cold water before serving—takes fever out," "cabbage causes sickness unless fever is soaked out of them in salty water," "cook vegetables in plenty of water to keep from making sick," "always add water to tomatoes in cooking so they won't hurt you," "cut onion and set in water to avoid indigestion," "if you're going to fry white potatoes, peel and let stand in salty water before frying to draw poisons out of them."

In the group including those vegetable preparation rules implying aims usual to general cookery which are classified in group IV, by far the most common were rules implying that long cooked vegetables were more tasteful. White homemakers gave 106, Negro homemakers 21 such rules. It is possible that the tradition for long cooking of string beans was recorded because of its great popularity, while traditions for long cooking of some of the other vegetables or for all vegetables, being less popular, were not recorded (at least in the cookbooks examined). On the other hand, a few women may have read in cookbooks to cook string beans 1 to 3 hours, depending on maturity, and in passing along the information, merely said "cook string beans a long time"—or transferred the idea for long cooking of string beans to all vegetables or to particular vegetables.

Fifty-five of the 107 long-cooking-of-vegetable rules reported by white homemakers and 9 of the 23 reported by Negro homemakers concerned long cooking of string beans. Some of the most common of these rules were: "Cook string beans until they shrivel," "let string beans cook until they fry," "the longer you cook string beans the better they are," "can't cook string beans too much," "always cook string beans a long time," "beans have to be cooked a long time to be good."

White women gave 35 rules concerning long cooking of all vegetables; Negro women gave 7. Some of the rules most often given were: "The longer you cook vegetables the better flavored they are," "always have vegetables on by 9:00 a.m. and let boil until dinner at noon," "gather vegetables early in morning and put on stove immediately," "cook vegetables a long time to be good." Other rules for long cooking of vegetables included seven for turnip greens by whites, one by Negroes; eight for cabbage by whites, two by Negroes; one for cowpeas by whites, two by Negroes.

The rule of next importance with an aim similar to the aim in general cookery classified in group IV was one pertaining to the temperature of water in which a vegetable should be started to cook. White homemakers gave 22 of these rules; Negro homemakers, 3 rules. Eight of the rules given by white women called for starting one type of vegetable in cold water and another type in hot or boiling water; i. e., "always put vegetables that grow under ground in cold water, above ground in hot water." The remainder either called for starting all vegetables or a particular vegetable in cold water or implied that the reason for starting in hot or boiling water was that cold water is toughening. Examples of rules of this latter type include: "Never put turnips on in cold water, for it hardens them," "when you don't have hot water to add to peas or beans, just pour your cold water down side of vessel to keep cold water from toughening," "don't add cold water to vegetables as it will toughen them." Nutrition specialists recommend starting all vegetables in boiling water (or adding boiling water to cooking vegetables should more be needed) in order to reduce cooking time and to destroy oxidases.

Twenty-five of the rules given by Negro homemakers and two by white homemakers attributed tendering powers to sugar, vinegar, and nails in preparing vegetables. Twenty-one of the rules reported by Negroes and one by whites were: "Put a pinch of sugar" or "a little sugar" or "sugar" in vegetables to tender or to cook quicker. This rule may have resulted from the fact that sugar and soda were often both added and that it was not possible to tell which "did the trick." Therefore, properties belonging to soda were attributed to sugar or vice versa. The rules "put a little vinegar in vegetables to cook quicker" and "drop a nail in tough beans to make them cook quicker," given by two Negroes and one white, may be examples of applying meat preparation rules to vegetable preparation. These rules were quite common in meat preparation, as will be noted in the discussion which is to follow.

Also included in the rules classified in group IV as having aims usual to general cookery, were 20 concerning reducing odors in vegetable preparation (17 reported by Negro women, 3 reported by white women). These rules may not be food preparation rules in the strict sense, but since they occur with preparation of vegetables, they are here included.

Seventeen of the rules applied to reducing odor or bad effects from odor of cooking cabbage, and three of the rules applied to reducing bad effects from odor of preparing onions. The most common rule, given by nine women (six Negro women and three white women) was: "When cooking cabbage, put a biscuit or a piece of stale lightbread on top of the cabbage to keep odor from going through the house." Other rules for reducing odor of cooking cabbage given by Negro women were placing a piece of cut onion on top of the cooking cabbage, sprinkling meal on the stove, and putting an open pan of water on stove to absorb odor.

According to the rules given by Negro women, one of the effects of the odor of cooked cabbage was to draw flies, and for this reason it was important to keep down odors. "When cooking cabbage, sprinkle a little meal on the stove to keep green flies away," "lay a piece of bread on top of boiling cabbage to keep flies away," "place a biscuit on top of cooking cabbage to keep flies away," are examples of such rules.

Six white women gave time-for-adding-salt rules; six Negro women use-of-soda-to-improve-taste rules. Five of the rules given by white homemakers called for adding salt when the vegetable was cooked. One was "add salt at beginning in cooking potatoes so won't break up." Food specialists recommend adding salt at the beginning in cooking potatoes as well as in cooking other vegetables, but not for the reason given. Four of the use-of-soda rules reported by Negro women applied to improving taste of all vegetables by addition of soda, two to improving the taste of particular vegetables. Here it is possible that properties of sugar were confused with those of soda.

One interesting rule reported by a white woman and classified in this group was "always add soda to string beans to take up the grease." This rule might be used as a basis in teaching to show that soda not only is destructive of vitamins but unites with fat and forms soap, resulting in probably a less palatable product and in the use of more fat than necessary for seasoning. It was classified with rules of group IV, for if beans were too greasy, the best way to reduce this greasiness would have been to reduce the amount of grease rather than to add soda. In other words, it has little basis.

Vegetable Preparation Rules of the Recipe Type

There were only 50 vegetable preparation rules included in group V, or the rules of the recipe type—5 reported by white women, and 45 by Negro women. Of those reported by Negro women, 35 were: "Add sugar to vegetables to make them taste better." Five mentioned addition of onion and four addition of vinegar to improve flavor. One read, "always cook vegetables with salt meat."

The rules given by white women and classified in this category differed very much from those given by Negro women. No white woman mentioned addition of sugar, vinegar, or onion to improve flavor. One, however, gave the rule "always use salt meat in cooking vegetables." Other recipe rules given by white women were: "Season English peas with milk and butter," "cabbage always takes less salt than any other vegetable," "cabbage needs very little salt," "put fat in bottom of boiler with flour and let brown. Add vegetable and water at about the same time. You will have same effect as though you had used meat."

Reasons Given for Vegetable Preparation Rules

About 20 percent of the vegetable rules given by white women and 80 percent by Negro women included a reason with the rule given (table 6). In both Negro and white groups, when a rule contained a reason, this reason was most frequently (1) to tender or cook quicker; (2) to make more healthful; i. e., keep from making sick, to get rid of poison, let sap out; (3) to improve flavor. Flavor was given more relative importance by whites; to tender or cook quicker by Negroes. It is possible that Negro women were more limited as to fuel (usually wood) than were white homemakers. Also, food preparation may have been an extra activity more often to Negro mothers than white mothers, and for this reason speed was more important. In interviewing homemakers the writer has found that lack of other activities sometimes accounts for long cooking.

It is interesting to see that so few women in reporting vegetable preparation rules taught by mother or someone else at home gave "to conserve vitamins," or "to make more nutritious" (table 6). When these same homemakers, however, were asked: (1) to give new vegetable dishes tried during previous year and what led them to try new dishes, and (2) to account for some of the differences in preparation of particular vegetables in own and in parental home, the superior nutritive value of the new dish or new method of preparation was frequently mentioned.[21] This would indicate that preparation to conserve nutrients is on the increase. Cooking to conserve nutrients would be expected

Table 6. Reasons for steps in preparation given in vegetable rules

Reasons for rules*	Reported by white women		Reported by Negro women	
	Over 40 years	40 years and under	Over 40 years	40 years and under
	Percent	Percent	Percent	Percent
No reason given	77.8	80.5	20.2	20.1
Reasons given	22.2	19.5	79.8	79.9
Reasons:				
To tender or cook quicker	4.8	5.2	27.8	34.5
Health**	4.2	4.3	24.7	20.8
Flavor	8.7	6.2	22.0	13.6
Odor	1.0	0	2.7	5.0
Texture	.4	0	.8	3.4
Color	1.0	1.4	.8	.8
Nutritive value	1.0	.9	1.0	1.4
To keep peeling from sticking on	0	.5	0	0
Remove insects	0	0	0	.4
Remove skins easily	.4	0	0	0
To take up grease	0	.5	0	0
So husks won't get in	.7	0	0	0
To keep from breaking up	0	.5	0	0
Total	100.0	100.0	100.0	100.0
Number of rules	288	210	223	264

*Main or first reason given is listed.

**Includes rules inferring disease or discomfort lodged in food and steps in preparation which must be followed to make more healthful to eat, get rid of poison, let sap out, to keep from being sick, and the like.

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[21] "Changing Pattern of Food Preparation of Small Town Families in Mississippi," Dorothy Dickins, Miss. Exp. Sta. Bull. 415, 1945. In press.

now. Fifteen, twenty, or thirty years ago, available nutrition information was limited, or almost nonexistent.

Meat, Poultry, Fish Preparation Rules

Three hundred and six rules taught concerning preparation of meat, poultry, and fish were reported by white and Negro homemakers of this study, 110 by whites and 196 by Negroes. Two hundred and fifty-seven were rules given for preparation of meat and meat products, 36 for the preparation of poultry (in practically all cases, chicken), 9 for preparation of both meat and poultry, and 4 for the preparation of fish.

As will be noted from the classification of meat, fish, and poultry rules in table 7, the majority (except the older Negro group) were classified in group II or in the group in accord with directions found in old cookbooks examined and now outdated. More of the rules reported by the older Negro group were rules that seemed to have little or no basis. Younger women reported more rules in accord with practices now recommended, while older women reported more that seemed to have but little or no basis.

MEAT, POULTRY, AND FISH PREPARATION RULES IN ACCORD WITH PRACTICES NOW RECOMMENDED

White women gave 14 rules, Negro women 13 rules which included practices now recommended by nutrition specialists. Twenty-three of these rules pertained to cooking at low temperature (or slow cooking), 3 concerned short cooking, and 1 was a negative rule: "Never salt chicken until it is ready to cook." Formerly, when cooling facilities were very poor, dressing and salting both inside and outside of the chicken a day before cooking was common. However, salting ahead no doubt dissolved nutrients, especially if the skin was broken which was more than likely the case since defeathering was usually done by plunging the fowl in boiling water.

Twelve meat, fish, and poultry rules reported by Negroes and 13 reported by whites classified in group I were in accord with technical recommendations of food specialists and suggested cooking meat (or tough meat) with cover to tender, dressing poultry ahead to tender, freezing to tender, cooking with less water to improve flavor, using little fat in broiling, care against overpricking meat in testing, sticking in nails to cook more quickly.

Rules pertaining to the use of a small amount of water in cooking meat were classified in group I even though addition of water is not recommended in cooking tender meat. It seemed very likely that most of the meat secured by the families of these women was tough, since the majority lived on farms or in small towns where a supply of tender meat was usually not available. Rules such as "always keep lid tight on meats—tenderer" were likewise classified in group I, though they apply in particular to tough meats. In 74 of the rules given by Negro homemakers and in 6 given by white homemakers, tough meat or tough chicken was specifically mentioned.

One interesting type of rules reported only by Negro women in this study was a rule concerning use of nails or rusty nails in cooking, to tender or cook quicker. In most of the rules these nails must be put in the meat or chicken, but a few suggested that they be dropped in the pot. Since food investigators have shown that metal skewers inserted in meat do cause meat to cook quicker, the three rules of this type were classed in group I.[22] However, the majority of rules referred to putting nails in meat to tender, or to putting nails in the pot with meat or chicken to cook quicker or to tender. These rules were classified in group IV, or as rules having little or no basis.

Use of nails in meat cooking may have come from the practice of cooking meat over coals on metal skewers—a practice before cook stoves were common. It is likely that these metal skewers were rusty and so the nail or the rusty nail was substituted when cooking on a stove. In other words, an old practice might be followed in a changed form when new equipment appears even though not necessary or desirable.

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[22] "A Study of Certain Factors Affecting Shrinkage and Speed in the Roasting of Meat," Agnes Fay Morgan and Mabel P. Nelson, Jour. Home Econ., 18:371-378, 444-448 (1926).

"Cooking Losses and Cooking Time of Roasts as Affected by Use of Skewers," Alice M. Child, Rept. of Review Comm., Coop. Meat Investigations (1937).

"The Effect on the Tenderness of Paired Roasts When Faster Cooking is Produced by Means of Metal Skewers," Sylvia Cover, Annual Rept. Nat. Livestock and Meat Board, 1937-38, pp. 110-11, and Tex. Agr. Sta. Annual Rept. 1937, pp. 141-42.

Meat, Poultry, and Fish Preparation Rules in Accord With Directions Found in Old Cookbooks Examined, Now Outdated

As will be noted in table 7, practically all meat, poultry, and fish preparation rules in group II were outdated because better technical methods have been developed, or because of changes in processing. The five rules given outdated because of increased knowledge of nutrition (four reported by Negro women, one by a white woman) pertained to washing chicken in soda water before cooking, soaking liver 30 minutes before frying to draw out the blood, and parboiling brains.

The majority of meat rules classified in group II concerned adding vinegar (and in a very few cases lemon juice) to tender. This rule was reported by 62 Negro and 4 white women. Perhaps, if the practice had been as common a tradition among white families, it would have been found in more than one of the cookbooks examined and been assigned a place in the meat section of the cookbook in which it was found, rather than in the back of the book with "Facts Worth Knowing."[23]

The use-of-vinegar rules reported by homemakers of this study called for rubbing a little vinegar on meat or chicken, or for washing meat in vinegar water, or for putting a little vinegar in the pot during cooking. Only one rule given—that by a white woman—called for marinating overnight. According to investigations made at Iowa State College,[24] the effect of adding acid to meat for increasing tenderness depends primarily on the length of time the acid is in contact with the meat. The vinegar-treated beef was decidedly more tender than the control

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[23] Zieman and Gillette, op. cit., p. 541.

[24] Palatability Studies with Meat. II. A Comparison of Three Brining Solutions in Paired Less Tender Cuts of Beef, Cooked by Moist Heat, E. R. Crain, Master Thesis, Iowa State College, 1938.

Palatability Studies of Meat. III. The Effect of Brine Solutions on the Fiber and Connective Tissue of Paired Tender Cuts of Beef, G. E. Tofte, Iowa State College, Master Thesis, 1940.

Table 7. Classification of meat, poultry, and fish preparation rules taught white and Negro homemakers

Item	Reported by white women		Reported by Negro women	
	Over 40 years	40 years and under	Over 40 years	40 years and under
	Percent	Percent	Percent	Percent
Preparation rules:				
(1) In accord with practices now recommended	17.5	38.8	9.1	17.6
(a) By nutrition specialists (nutrition recommendations)	9.3	19.4	7.2	5.8
(b) By food specialists (technical recommendations)	8.2	19.4	1.9	11.8
(2) In accord with directions found in old cookbooks examined, now outdated	31.2	30.7	39.6	42.4
(a) Because of increased knowledge of nutrition	0	2.8	2.7	1.2
(b) Because of better technical methods developed by food specialists or changes in processing	31.2	27.9	36.9	41.2
(3) In accord with observation but not found in old cookbooks examined, now outdated	17.5	8.3	2.6	0
(a) Because of increased knowledge of nutrition	1.4	2.8	0	0
(b) Because of better technical methods developed by food specialists or changes in processing	16.1	5.5	2.6	0
(4) Seeming to have but little or no basis	28.4	19.4	43.3	35.3
(5) Of the recipe type	5.4	2.8	5.4	4.7
Total	100.0	100.0	100.0	100.0
Number of rules	74	36	111	85

after being marinated for 72 hours, using vinegar solutions (25 c.c. of vinegar and 75 c.c. of water per 100 grams of meat). However, the concentration of the acid was much greater near the surface than in the interior of the meat, showing that even 72 hours is not enough time for the vinegar to penetrate sufficiently into the meat to bring about equilibrium of acid in the meat. Putting a little vinegar on the meat or in the pot or washing with a little vinegar would, therefore, not make it tender.

White women gave 17 rules, Negro women 6, concerning need for starting meat in boiling water or in a hot skillet to keep in the juices. All old cookbooks examined gave the searing-to-keep-in-juices rule. In her recipe for roast beef, Harland, for example, stated: "It is a good plan to dash a small cup of boiling water over meat when putting it into oven—checks escape of juices."[25] By 1935, research work had definitely disproved the theory of searing to keep in juices.

Six rules given by white homemakers and five by Negro homemakers concerned need for adding salt after meat was tender, since salt toughened or let out the flavor. Similar rules were found in the White House cookbook which stated: "It hardens any meat to salt when it is raw,"[26] and the Boston cookbook, "Salt draws out the juices."[27] The Department of Home Economics of the National Livestock and Meat Board recommends salt added to broiled meat after browning. They state it makes little difference when a roast is salted. Salting any piece of meat cooked by moist heat at the beginning of the cooking period is recommended by them.[28]

Four meat rules given are outdated (three referring to parboiling salt pork and one to boiling ham) because of the use of less salt in curing. Parboiling or cooking in large quantities of water is no longer necessary as in the past. Ham is now baked at low temperature with no water.

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[25] Harland, op. cit., p. 98.

[26] Zieman and Gillette, op. cit., p. 105.

[27] Lincoln, op. cit., p. 14.

[28] Letter, Dec. 4, 1944, from Jessie Alice Cline, Home Econ. Dir., Nat. Livestock and Meat Board.

Meat, Poultry, and Fish Preparation Rules in Accord with Observation But Not Found in Old Cookbooks Examined, Now Outdated

There were only 19 meat, poultry, and fish rules classified in group III, or as rules based on observation but not in accord with present recommendations. All except two were outdated because of better technical development or changes in processing. Both were "always parboil wild meats." Deer was probably referred to in these two cases, for the "gamey" taste of venison was mentioned as undesirable by several in connection with another phase of this same study.

Fourteen of the 19 rules classified in group III pertained to boiling meat then baking (or browning) in oven. This procedure, it was said by those giving a reason with the rule, made tender meat. The method of cooking tough meat recommended by food preparation specialists is braising. Browning at the beginning of the cooking period is an essential part of braising. In braising, the meat is browned in its own fat or in a small amount of added fat. The browning is usually done on the top of the stove, but may be done in the oven. Liquid may or may not be added. If it is added, only a small amount is used. After browning, the heat is reduced, the container tightly covered, and cooking continued.

No recipe could be found in the old cookbooks examined of boiling and then browning meat in the oven, except in the case of cured ham and of turkey. It is possible that the method used in preparing cured ham was applied to other meats such as fresh pork and beef. It is interesting to note that no Negro woman gave the boiling and baking rule. Perhaps this was a special cooking tradition of fairly well-to-do families ordinarily preparing large roasts and/or turkey.

Three rules were given by Negro women pertaining to use of "lots of water" or "plenty of water" and "long cooking" to tender. Such procedure would tender but would produce poorer flavor than if cooked in little water.

Meat, Poultry, and Fish Preparation Rules Seeming to Have But Little or No Basis

Negro women gave six rules, white women only one, stating or implying that the aim in cooking meat or particular kinds of meat was to make it healthful to eat. This type of rule was, therefore, relatively unimportant for preparation of meats, but, as will be recalled, important for preparation of vegetables. Three of these rules pertained to washing chicken in soapy water to remove germs.

Of those meat rules classified in group IV and whose aim seemed to be that usual in cookery; i. e., a tender, palatable product, by far the most important reported by white women, concerned the need for long cooking of meat: "Always cook meats a long time," "always cook meat until it falls apart," "always cook meat until thoroughly done," "can't cook fresh pork too much," and "can't boil meat too much."

Long-cooking meat rules may have come from need for long cooking of pork to destroy trichinae. However, one can cook even pork too much. Any overcooking of meat reduces nutritive value as well as makes the meat less palatable and less attractive in appearance. It is common observation that the great majority of people in the South prefer meat very well done. This preference no doubt came in part from the fact that the South was largely rural, consequently using a large amount of pork which could be easily produced on the farm.

The meat rule reported by more Negro women than any other classified in group IV, concerned putting nails in meat to tender or dropping in pot for tendering or cooking quicker. Sixteen of the 26 rules here given mentioned rusty nails. The investigators, Morgan, Child, and Cover, as has been previously stated, have shown that use of metal skewers in meat cookery reduces cooking time and cooking losses, but Cover has shown in her study that meat cooked with metal skewers is not as tender as the control.[29] Therefore, putting a nail or a rusty nail in meat to tender has no basis.

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[29] See reference in footnote 21.

Negro women gave 25 rules, white women 1 rule, for use of soda in cooking or in washing meat in order to tender. These rules may have been carried over from use-of-soda rules in vegetable cookery. Addition of soda during cooking or washing in soda water before cooking will not make meat tender. Soda will increase destruction of thiamin.

Six rules for use of sugar in meat to tender or cook quicker were given by Negro women. Sugar will not tender meat any more than it will tender vegetables. It would seem that a few of the Negro mothers associated soda and sugar with tendering, not only of vegetables, but of other foods, such as meat and chicken.

Among other rules classified in group IV were those attributing properties to oven cooking, to the use of the lid, starting in hot water, refraining from sticking a fork in meat, that such ways of preparation did not have. Cooking inside stove or in oven was said by two white women and one Negro woman to make meat more juicy or give better flavor, one and the same, since meat flavor is mostly in the juice. Retaining juice depends on the temperature, not place of cooking. One rule given by a white woman stated that cooking beefsteak without lid and adding a little water would make tender. One rule reported by a Negro woman stated that putting on lid guaranteed tenderness. Cooking with a lid would help make meat tender, but certainly would not guarantee it. One Negro woman reported that cooking meat without sticking a fork in it would make it tender, while a white woman stated that starting meat in cold water would toughen it. Neither statement is true.

Meat, Poultry, and Fish Preparation Rules of the Recipe Type

There were only 15 meat, poultry, and fish preparation rules included in group V, or rules of the recipe type—5 reported by white women, 10 by Negro women. Seven of these rules reported by Negroes and two by whites referred to addition of vinegar or lemon juice for improving taste. The other three rules given by Negro women concerned putting a little sugar in meat to make taste better, while the other three reported by whites concerned addition of particular vegetables in cooking meat, and to rubbing beefsteak with olive oil before broiling.

Reasons Given for Meat, Poultry, and Fish Preparation Rules

As is shown in table 8, to tender was the reason most often accompanying meat rules reported by both white and Negro women, although Negroes mentioned to tender about two times as often as whites. Cooking quicker was next in importance to Negroes to keep juices in, or make juicier to whites.

It is interesting to note that nutritive value was not mentioned by any woman, white or Negro, in connection with meat, poultry, and fish preparation rules. As will

Table 8. Reasons for steps in preparation given in meat, poultry, and fish rules

Reasons for rules*	Reported by white women		Reported by Negro women	
	Over 40 years	40 years and under	Over 40 years	40 years and under
	Percent	Percent	Percent	Percent
No reason given	40.5	36.1	7.2	7.1
Reason given	59.5	63.9	92.8	92.9
Reasons:				
To tender**	32.4	38.9	67.6	64.7
To cook quicker	----	----	8.1	12.9
Flavor	5.4	11.1	9.9	8.2
To keep in juices or make more juicy	20.3	13.9	4.5	2.4
Health***	1.4	0	2.7	2.3
To keep grease from popping	0	0	0	1.2
To draw out blood	0	0	0	1.2
Total	100.0	100.0	100.0	100.0
Number of rules	74	36	111	85

*Main or first reason is listed.

**Includes rules such as "rub tough meat with vinegar" as well as rules such as "rub meat with vinegar to tender."

***Includes rules inferring disease or discomfort lodged in food and steps in preparation must be followed "to kill germs," "destroy acids," "better for you," "to draw out heat."

be recalled, it was mentioned by very few in vegetable preparation rules. It is only recently that methods have been worked out for studying vitamin losses in meat preparation. Then, too, in preparing meat the cooking water (or gravy) is eaten, not thrown out as vegetable cooking water often is.

CAKE PREPARATION RULES

There were 80 cake preparation rules given by the 1,158 homemakers of this study—76 by white women and 4 by Negro women (table 9). Three of the four cake rules given by Negro women were accompanied by a reason—one in order to make lighter and two in order to keep cake from falling. Sixteen of the 76 cake preparation rules reported by white women were accompanied by a reason—7 to keep cake from falling, 4 to make a smoother or better texture, 4 to cook or rise more evenly, and 1 to make a better cake. It would thus seem that keeping from falling is as important in cake preparation as making tender is in vegetable and meat preparation.

It is interesting to note that all 27 rules classified as in accord with practices now recommended were technical recommendations. No rule concerning a nutrition recommendation was given. This was, no doubt, because it is only recently that methods for determining vitamin B_1 have been worked out and that investigations on the effect of baking powder and soda on this vitamin have been made.

That there was no rule reported concerning the effect of excess soda or baking powder on taste and texture may be accounted for by the fact that cakes are prepared by recipe, since hit-and-miss proportions are likely to make the cake fall.

The conventional method of preparing a cake taught by home economists is to cream fat, add sugar gradually, then egg yolks. After that, add the sifted flour, baking powder, and salt mixture alternately with the liquid, beginning and ending with the former, and finally stirring in beaten whites.

Table 9. Classification of cake preparation rules taught white and Negro homemakers

Item*	Reported by white women		Reported by Negro women	
	Over 40 years	40 years and under	Over 40 years	40 years and under
	Number	Number	Number	Number
Preparation rules:				
(1) In accord with practices now recommended by food specialists (technical recommendations)	16	10	0	1
(2) In accord with directions found in old cookbooks examined, now outdated because of better technical methods by food specialists	5	6	0	0
(4) Seeming to have but little or no basis	19	16	2	1
(5) Of the recipe type	4	0	0	0
Number of rules	44	32	2	2

*No rule classified in group III.

Sixteen of the 27 cake rules classified in group I were tests for doneness. Thirteen were: "Put broomstraw in cake and if it comes out clean, cake is done." The two other tests for doneness rules classified in this group were: "Cakes are done when they turn loose from the side of the pan," "in touching a cake, you leave fingerprints if it isn't done." Two women gave this latter rule.[30]

Five of the other 11 cake rules classified in group I concerned creaming butter and sugar thoroughly. Two pertained to time of adding flour and liquid; i. e., "Never put liquid in cake batter until flour is added," "always start with flour and end with flour in making cakes." The other four rules, the first reported by a Negro woman, were: "Beat egg whites separately. Fold in last. Makes cake lighter," "always cook cake at beginning at lower temperature, then raise temperature," "let cake set after taking out of oven a while before icing," "if you use too much sugar in cake, it falls." All of these rules conform with instructions of food specialists.[31]

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[30] These three tests are mentioned in scientific food preparation books, such as "Hows and Whys of Cooking" by Halliday and Noble. However, it is stated that the cake should shrink only slightly; that if it shrinks too badly, it is overbaked and that the cake should be touched "lightly with the fingers."

There were three types of cake rules classified in the group in accord with directions found in old cookbooks examined, but now outdated because of better technical methods. Six of these rules concerned the need for beating cake batter thoroughly, or for a long time. Three stated: "Don't open door to oven when cake is baking, makes fall." Two were: "Beat cake batter; never stir." Similar statements found in the old cookbooks examined were: "All cakes made with butter require to be beaten long and vigorously after adding flour that they may be smooth grained,"[32] "the cake should be quickly examined and the door shut carefully. The rush of cold air will cause it to fall," "never stir cake after butter and sugar are creamed but beat it up and over. This laps air into batter and produces little air cells."[33]

Twenty of the 38 cake preparation rules classified in group IV concerned warnings against running around in the kitchen when the cake was baking, as the jar would make the cake fall. According to Mrs. Snyder of the Wheat Flour Institute, it would take a very severe "shake" to accomplish this. "If the bread is extremely rich, like cake, there might possibly be some tendency for it to fall if it were jolted at the critical moment."[34] This rule would, therefore, seem to have but little basis. Fallen cakes have, without doubt, been frequently blamed on playing children when the cause was inaccurate measuring, poor mixing, or baking procedures.

Four rules in group IV concerned need for baking very slowly or at a low temperature. According to food specialists, cake baked at slow temperature has thicker cell walls, a coarser and less velvety texture.

Another four rules in this group concerned beating cake batter; i. e., "Can't beat cakes too much" (reported by two women), "the more you beat your cake, the smoother the texture," "don't beat cake batter" (reported by one each). Halliday states that plain cake with phosphate baking powder cannot be beaten longer than 1 minute, cake with tartrate baking powder 2 minutes, whereas cake with sulfate phosphate powder will stand 10 minutes.[35]

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[31] See "Hows and Whys of Cooking," E. G. Halliday and I. T. Noble, Univ. of Chicago Press, 1936, Ch. IV.

[32] Lincoln, op. cit., p. 373.

[33] Zieman and Gillette, op. cit., p. 269.

[34] Taken from a letter received Dec. 10, 1943.

Attention may be called here to the total lack or overlap between tradition and use of materials, such as baking powder. Even though it has been 23 years since Halliday published the article on "The Effect of Beating Cake Made with Different Baking Powder," no mention was made in rules reported of any difference in procedure when using different types of baking powder. Food rules passed on from mothers to daughters of this study, no matter what the food, seldom contained **specific** methods of procedure. Perhaps one explanation for the large number of vegetable rules reported was that in vegetable preparation greater latitude of procedure is possible.

Information given in rules of the recipe type was itself usually most general, i. e., "Add a little sugar to string beans to make taste better," "season English peas with milk and butter," "a little vinegar added to meat improves its flavor." The four rules of the recipe type given for cake, in three cases, "use the 1-2-3-4 recipe in making cakes," and in one case "in making cakes use the 1-2-3-4 rule, only use ½ cup of fat instead of 1 cup," were somewhat more specific though there was likelihood of forgetting whether the three applied to eggs or to cups of flour.[36]

The other 10 cake rules classified in group IV seeming to have little or no basis varied widely. Three referred to putting a pan of cold water in the oven when baking a cake, to cook more evenly. Two advised folding in baking powder last. Two gave tests for sufficiency of mixing; i. e., "Test cake batter by dropping it in cold water. Ready to bake if dough will float." The other three rules were as follows: "Always shake cake pan after putting in the oven to make cake rise evenly," "have thin batter to make a good cake," "always put spices and seasoning in before measuring flour in making cake." In the case of the first rule listed at the beginning of the paragraph, putting a pan of cold water in an oven that was too hot for the cake would reduce the temperature. However, according to Monroe, steam causes cracking of certain cakes due to faster heating of the surface.[37]

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[35] Effect of Beating Cake Made with Different Baking Powder, E. G. Halliday, Jour. Hom Econ., Vol. 12, p. 42, (1920).

[36] In the discussion given by Belle Lowe in her "Experimental Cookery," 1943 Edition, pp. 514-15, on balancing cake formulas, she states: "Bakers have different rules for balancing cake formulas, but they state that there will always be exceptions to these rules. They also mix larger quantities in one batch than the housewife. It is well known that in large-quantity cookery the proportion of liquid must be decreased. In many instances, the rules given in bakery trade journals sift down to the following or similar suggestions: (1) The weight of the fat should not be over one-half the weight of the sugar; (2) the weight of the fat should not exceed the weight of the eggs; (3) the weight of the sugar should not exceed the weight of the flour; (4) the weight of the liquid (milk plus eggs) should equal the weight of the flour.

The 1-2-3-4 rule, it was found, is 1 cup fat, 2 cups sugar, 3 eggs, 4 cups flour. Usually 1 cup of milk is added. Compared with suggestions above, it will be found that the weight of the fat exceeds the weight of eggs. However, in one of the four rules given, one woman stated: "In making cakes use the 1-2-3-4 rule, only use ½ cup of fat instead of 1 cup." This would seem to be more in line with the formula above.

BREAD PREPARATION RULES

Forty-five rules concerning preparation of breads were reported—42 by white homemakers and 3 by Negro homemakers. The fact that so few Negro women reported bread preparation rules taught may have been because bread in parental homes of many of these women was mostly cornbread made with meal, salt, water, and fat. Preparation of this bread probably provoked few rules since there was no problem such as of toughness or of poison to destroy.

Twenty-six of the bread rules concerned preparation of cornbread, 13 of biscuit, 5 of yeast bread, and 1 of both biscuits and cornbread.

As may be noted in table 10, all bread preparation rules classified in group I were technical recommendations, as were cake rules in this group. One bread rule, however, classified in group V, "Always use ½ teaspoon soda to 1 cup sour milk in making cornbread," might have been placed in group I and classed as a nutrition recommendation since the proportion of soda to acid is important, for an excess of soda is destructive of vitamin B_1 in the cornmeal. One-half teaspoon of soda to a cup of sour milk is according to proportions recommended by the Nutrition Specialist of the Mississippi Extension Service.[38]

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[37] "Effect of Steam on the Baking of Foods," Merna M. Monroe, Jour. Home Econ., Vol. 36, No. 2, p. 103, Feb. 1944.

Nine of the 20 bread rules classified in group I, or rules in accord with practices now recommended by food specialists, concerned starting cornbread or biscuit in a hot oven and/or cooking quickly (table 10). (It is quick rising which is largely responsible for lightness of well-made breads; and lightness, in turn, largely determines the grain and texture of baked products.) Four rules pertained to kind of dough or batter; i. e., soft or thin. These rules, too, have a scientific basis. A dry dough tends to crumble and break, making biscuits that split badly at the sides during the baking period.

Table 10. Classification of bread preparation rules taught white and Negro homemakers

Item	Reported by white women		Reported by Negro women	
	Over 40 years	40 years and under	Over 40 years	40 years and under
	Number	Number	Number	Number
Preparation Rules:				
(1) In accord with practices now recommended by food specialists (technical recommendations)	16	3	1	0
(2) In accord with directions found in old cookbooks examined, now outdated because of better technical methods by food specialists	0	4	0	0
(3) In accord with observation but not found in old cookbooks examined, now outdated because of better technical methods by food specialists	1	0	1	0
(4) Seeming to have but little or no basis	4	2	0	0
(5) Of the recipe type	7	5	1	0
Number of rules	28	14	3	0

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[38] "Breads and Bread Cookery," May Haddon, Miss. Ext. Service, Mimeo. material.

Among other bread rules classified in group I were: "Always have muffin pans hot before putting cornbread on," "always turn corn muffins over as soon as taken out of oven," "good biscuits are the result of working with the hands," "measure all ingredients for biscuits," "always chill dough before making biscuits."[39]

Two of the four bread rules classified in group II concerned mixing cornmeal, salt, and sour milk ahead and adding soda and fat later. The other two were: "Never use hot water in making rolls," and "always let yeast bread set overnight to make lighter." Similar rules found in cookbooks examined were: "One cup of flour, one cup of cornmeal, two tablespoonfuls of sugar, water to make a thick batter or sour milk is better; mix at night; in the morning add 2 tablespoonfuls of fat and 1 teaspoonful of soda,"[40] "one pint lukewarm water,"[41] (Modern recipes call for heating water and/or milk to boiling, adding fat and sugar, cooling to lukewarm before adding yeast), "cover closely that neither dust nor air can get in, and set in a warm place. It will rise in 8 or 9 hours. In the morning shape into loaves or rolls."[42]

There were only two bread preparation rules classified in group III: "Burn red corn cob to make soda for making biscuits," and "always use heavy iron skillet in making cornbread." Burning a red corn cob would produce potassium and sodium carbonate instead of sodium bicarbonate. One would get carbon dioxide, but corn cob soda would not be very satisfactory. A heavy iron skillet was used in days of fireplace cooking and this was undoubtedly a tradition carried over from that period.

Six of the bread preparation rules reported seemed to have little or no basis. Two contained warnings against jarring the floor when yeast breads were rising (already discussed in connection with cake). Some of the others were: "Always measure dry ingredients for making biscuit before sifting," "the quicker you bake cornbread, the better it is," "always let biscuit dough set overnight to make lighter." One is supposed to use a quick oven in cooking cornbread, but it is possible to have the oven too hot. The last rule mentioned may have been carried over from recipes for biscuit with yeast added. However, in Mississippi, when the word "biscuit" is used, reference is ordinarily made to soda or baking powder biscuit, or biscuit made with both soda and baking powder, not yeast.

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[39] For basis of first, second and third rule see: "Breads and Bread Cookery," May Haddon, Miss. Ext. Service, Mimeo. material. For basis of statement that good biscuits are result of working with hands see: "Hows and Whys of Cooking," Halliday and Noble, p. 115. For basis for statement "Always chill dough before making biscuits," see Jour. of Home Econ., Mar. 1926, p. 157, "The Effect of Delayed Baking Upon Biscuits," by Eleanor E. Maclay.

[40] Zieman and Gillette, op. cit., p. 245.

[41] Lincoln, op. cit., p. 63.

[42] Parloa, op. cit., p. 382.

The thirteen rules of the recipe type, with the exception already discussed, all referred to putting eggs or not putting eggs, or to putting buttermilk, or water, or eggs and buttermilk, in cornbread. One interesting rule of the recipe type was: "Always make cornbread with just milk, as bread with eggs is not good when cold."

FOOD PRESERVATION RULES

There were only 21 food preservation rules reported, 18 by whites and 3 by Negroes. Five of these rules were classified in group I; nine in group III; three in group IV; and the remainder in group V. The small number of food preservation rules given may be because food preservation was more often done by recipes. If good directions are not carefully followed in food preservation, foods will spoil.

Three of the five rules classified in group I concerned jelly-making (all rules containing technical recommendations): "Always cook a small amount of jelly at one time," "when it boils in large bubbles, jelly is done," "always drain juice for jelly through a flannel bag; never squeeze; always let drip." Draining juice through a flannel bag and never squeezing would make a clear jelly. This rule is placed in group I on the assumption that clearness is a quality desired.

The other two rules (also technical rules) classified in group I concerned pickle-making and were: "Never put hand in brine, for it spoils cucumber. Use a wooden spoon," "always put grape leaves over cucumber pickles to make greener." Putting a hand in the brine might cause spoilage if the hand were not clean, especially if the acidity of the brine were low. Food specialists recommend addition of acid or vinegar in brining cucumbers, since this reduces spoilage.[43] It is probable that the cucumbers would absorb some of the chlorophyll from the grape leaves and, therefore, the second statement can be classified in group I.

Five women reported: "Fry fresh pork. Pack in stone jars. Pour grease over it. Tie tightly and store in cool place. This is good for a month." This rule was classified as based on observation, but not in accord with present recommendations (group III). When this rule was handed down from mothers to daughters, steam pressure canners were not available; the rule was in all cases reported by older women. Food specialists now recommend that fresh pork be canned by the steam pressure method or put in the cold storage locker.

Other preservation rules classified in group III were: "Always use a brass kettle in making pickles," "put kraut up in rain water to make it keep," "always let fruit stand in sugar overnight for preserving." Use of a brass container in making pickle would tend to make pickle greener since brass is an alloy containing copper. Copper, however, is destructive of vitamin C. Minerals contained in well water no doubt often interfered with fermentation of kraut and thus the rule for making kraut with rain water.

The last rule—"Always let fruit stand in sugar over night for preserving"—was outdated because of increased knowledge of nutrition as well as development of better technical methods. Standing overnight in sugar was done to give the juice time to come out of the fruit and make addition of water unnecessary. However, flavor was not improved thereby as was probably intended. Modern canning research shows the shorter the time from orchard to jar, the better the flavor and the less the loss of valuable nutrients.

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[43] Experimental Cookery, Belle Lowe, John Wiley & Sons, New York, 3rd ed., pp. 95-96.

There were three food preservation rules placed in group IV: "Cook jelly until it strings," "when canning, turn hot jars bottom upward to make them seal well," "pickle will spoil if the maker is menstruating at time of putting them up." The latter rule is probably one of the taboos in connection with menstruous women handling food and/or cooking food.[44]

Three of the four rules of the recipe type concerned time for setting cucumbers and watermelon rind in brine before making pickles. The other, also a pickle preparation rule, was "use 9-day method of pickling peaches." This method was probably heating and pouring hot vinegar-sugar sirup over peaches each morning for 9 days.

OTHER FOOD PREPARATION RULES

White women reported 17 rules, Negro women 18, pertaining to preparation of foods or food types not already discussed. Included in this list were: butter, buttermilk (or sour milk), cottage cheese, fruits, fats, mayonnaise, cereals, starchy foods, pastry, meringue, salad, eggs, candy, and coffee. Sixteen of these 35 rules were classified in group I, 2 in group II, 3 in group III, and the remainder (14 in number) in group IV.

Six of the 16 rules concerning preparation of other foods classified in group I were rules for fruit preparation. Four were recommendations of nutrition specialists, two were technical recommendations. An example of the former type is: "Bake apples with skins on;" of the latter type, "To keep bananas or cut apples from turning dark, put a few drops of lemon juice on them." This latter rule is probably nutritionally sound as well as technical, since lemon juice apparently delays oxidation and hence destruction of vitamin C.

Among other rules classified in group I were: "Always make coffee just before using and have pot spotlessly clean," "clear up fats by straining and pouring in clean can," "chill pie crust before rolling, so it will be tender." This last rule, however, may not apply in all cases. According to Halliday, "The fat and flour mixture" or "if necessary the dough before rolling should be chilled, if fat shows a tendency to melt."[45] Chilling dough was, no doubt, desirable in kitchens of mothers passing on these rules, since much of the cooking was done in very warm kitchens. Kitchens were warm because wood and coal ranges were used and because of the climate in Mississippi where most of the mothers resided.

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[44] Taboo and the Perils of the Soul, J. G. Frazer, Macmillan, 1935, pp. 95-96, 145-46.

The two rules concerning preparation of "other" foods classified in group II were: "Always cook boiled eggs a long time to make digestible" and "put an egg shell in coffee to clear." The first is outdated because of increased knowledge of nutrition and the second outdated because with coffee dripolators and percolators one no longer has the problem of clearing coffee. Statements similar to the two given which were found in the old cookbooks examined were: "Put eggs in hot water to cover and boil 20 minutes. Ten minutes will boil them hard, but they are not so digestible as when boiled 20 minutes. Ten minutes makes yolks hard and soggy. Twenty minutes makes them light and mealy."[46] "Coffee (common coffeepot): 1 heaping tablespoon ground coffee, 1 square inch isinglass or 1 egg shell, 1 cup boiling water."[47]

All three rules classified in group III concerned warnings against making candy on a rainy day or in rainy weather. One stated in the rule given: "It won't get hard." We know, of course, that concentrated sugar solutions, such as candy, do absorb moisture from the air. However, food specialists now recommend cooking candy to a higher temperature in rainy or damp weather.

The 14 rules concerning preparation of "other" foods or food types classified in group IV were quite heterogenous.

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[45] Halliday, op. cit., p. 126.
[46] Parloa, op. cit., p. 374.
[47] Lincoln, op. cit., p. 115.

Four concerned ways to make butter come, or milk sour, quickly. All of these four rules were reported by Negro women and were: "Drop a teaspoon in milk to make it sour," "put a rusty nail in the churn to make the butter come" (reported by two women), and "put a little soda in milk when churning to make butter come quick." Adding soda to milk when churning might have the opposite effect from the one stated. There is no basis known to the writer for the first two statements.

Three of the 14 rules classified in group IV concerned starting starchy foods or rice in cold water. Three pertained to the use or preparation of fats, one to preparation of mayonnaise. The remaining were: "Put a pinch of baking powder in meringue to keep it from falling," "pie crust made with milk is tenderer," "bake apples a long time." There is little, if any, basis for these statements.

PREPARATION RULES APPLYING TO ALL FOODS

The women of this study reported 27 rules that applied to no particular food or food type. Twenty of these rules were given by white homemakers, seven by Negro homemakers. Thirteen of the 27 rules were classified in group I, 10 in group IV, and 4 in group V.

Three of those in group I pertained to short cooking of all foods: "Take up foods as soon as tender," "don't cook foods too long, makes mushy," "don't overcook food." "Cover all foods when cooking" was another rule containing a recommendation with some nutritional significance, since cooking with a lid conserves vitamins as well as fuel.

Among rules containing technical recommendations classified in group I were: "Always serve hot foods hot and cold foods cold," "whenever food scorches, remove from the fire and set in vessel of cold water to take out scorched taste" (when food cools quickly, the scorched taste does not penetrate through the food), "always follow recipes accurately," "always measure accurately all ingredients."

Seven of the 10 rules classified in group IV concerned long cooking, simmering, and/or slow cooking of all foods.

Two included the often heard, "Too many cooks spoil the stew." The other was: "Test oven by putting hand in before baking any kind of food." The test for an oven without a thermometer usually given is the time it takes to brown a particular amount of flour.

The rule, "use plenty of seasoning in food," reported by two women in slightly different versions, and a rule calling for the addition of sugar, and another for the addition of salt to every food cooked were the four included in group V.

Summary

The purpose of this report was to analyze 1,499 food preparation rules taught to 1,158 small town homemakers of Mississippi (698 white women and 460 Negro women) by their mothers or someone else in their parental home, as a basis for better understanding of food preparation practices now prevalent.

Median grade completed at school by white homemakers included was the twelfth; by Negro homemakers the sixth. Thirty-two percent of the white homemakers and 12 percent of the Negro homemakers had had training in a cooking class in public school and/or college.

About one-half of the white homemakers and eight-tenths of the Negro homemakers gave the interviewers one or more food preparation rules which they had been taught. More older women than younger women reported one or more rules taught. About 64 percent of the preparation rules given by white homemakers and 68 percent by Negro homemakers concerned preparation of vegetables.

More rules concerning preparation of particular vegetables were reported by white than by Negro women. Both groups mentioned particular vegetables more often than particular meats. The tendency to particularize vegetables more than meats, and especially on the part of white women, is thought to be because of greater variety of vegetables used. However, there was apparently a trend away from rules mentioning particular foods to rules mentioning food types since relatively more of the rules given by younger homemakers concerned food types; i. e., vegetables, cakes, meats.

Eleven percent of all preparation rules reported by white women and 3 percent of all reported by Negro women were negative rules. Three-fourths of the negative rules reported by white women and two-thirds by Negro women represent the more modern attitudes and beliefs, a much bigger proportion than in case of positive rules. These negative rules are probably associated with conscious cultural change, such as is involved in modern home economics education.

A classification of preparation rules by possible source, i. e., (1) oral tradition, (2) out-of-date written tradition, (3) scientific rule, was attempted but not found practical, since the source of the majority of rules was not determined. In this classification, rules accompanied with reasons implying unwholesome qualities in foods were classified as oral tradition. Rules appearing in old cookbooks examined, but now outdated because of increased knowledge of nutrition or development of better technical methods or changes in processing, were classified as out-of-date written tradition. Scientific food preparation rules were those in accord with present recommendations of nutrition and food specialists including nutritional and technical recommendations. On the basis of this classification by source, there seemed to be a tendency for younger white and Negro homemakers to report more often recommendations of nutrition and food specialists, for older white women to report more frequently out-of-date written material, and for older Negro women to report oral tradition accompanied with reasons inferring that unwholesome qualities exist in food that must be removed by preparation.

The food preparation rules reported by the homemakers of this study were classified into five groups for analysis: (1) Preparation rules which are in accord with practices now recommended by nutrition and food specialists; (2) preparation rules which are in accord with directions found in old cookbooks examined, but are now outdated because of increased knowledge of nutrition or better technical methods or changes in processing; (3) preparation rules which are in accord with observation but not found in old cookbooks examined which are now out-of-date because of increased knowledge of nutrition or better technical methods or changes in processing; (4) preparation rules seeming to have little or no basis; and (5) preparation rules of the recipe type.

The majority of rules reported by all groups (white and Negro, older and younger) were classified in group IV (seeming to have but little or no basis).

There were more vegetable preparation rules classified in group IV than classified in the other four groups combined. The most frequent type of vegetable preparation rule classed in group IV was a rule concerning preparation of new vegetables, especially new potatoes, which supposedly were unhealthful unless prepared in a particular manner. Negro homemakers also gave a number of vegetable preparation rules classified in group III. Many of these rules pertained to addition of soda to vegetables to make tender. White women gave relatively more vegetable preparation rules in accord with practices now recommended by specialists and more rules in accord with directions found in old cookbooks examined but now outdated. More of the "scientific" vegetable preparation rules and the outdated vegetable preparation rules concerned nutrition recommendations or were outdated because of increased knowledge of nutrition, than concerned technical recommendations or were outdated because of development of better technical methods or changes in processing. About 20 percent of the vegetable rules reported by white women and 80 percent by Negro women included a reason with the rule. In both Negro and white groups when a rule contained a reason, this reason was most frequently: (1) To tender or cook quicker; (2) to make more healthful, i. e., to keep from making sick, to get rid of poison, let sap out; (3) to improve flavor. Flavor was given more relative importance by whites; to tender or cook quicker by Negroes.[48]

Relatively more of the meat, poultry, and fish preparation rules were classified in group II. The most common rule in this group reported by white women was a rule concerning searing meat to hold in the juices, while Negro women more often gave a rule concerning use of vinegar to tender meat. More of the "scientific" meat preparation rules and the outdated meat preparation rules concerned technical recommendations or were outdated because of development of better technical methods or changes in processing than concerned nutritional recommendations or were outdated because of increased knowledge in nutrition. To tender was the reason most often accompanying meat rules reported by both white and Negro women, although Negroes mentioned to tender about two times as often as whites.

More cake preparation rules were classified in group IV, while more bread preparation rules were classified in group I. "Scientific" rules concerning preparation of cake and bread were technical recommendations. Outdated cake and bread rules were outdated because of development of better technical methods rather than increased nutrition information.

Among the types of transfer that seem to have occurred in connection with passing down food preparation information were: (1) Transfer of qualities of soda to sugar, or vice versa (soda makes tender, therefore, sugar will make tender; sugar makes taste better, therefore, soda will make taste better). (2) Transfer from vegetable to meat practices (soda makes vegetable tender, then will make meat tender). (3) Transfer from meat to vegetable practices (vinegar makes meat tender, then will make vegetables tender). (4) Transfer from one vegetable to another or to all vegetables: (a) If one starts vegetables that grow under ground in cold water, then one starts potatoes in cold water, then one starts starches in cold water; (b) If parboiling is good for strong vegetables, then it is good for other vegetables; (c) If parboiling is good for new vegetables, then it is good for old vegetables; (d) If string beans boiled 3 hours taste good, then why not boil turnip greens 3 hours? (5) Transfer from one meat to another or to all meats: (a) Vinegar is good for tough meats; therefore, good for all meats; (b) If a little vinegar makes meat tender, it will also make chicken tender; (6) Degeneration of a reality practice, as from cooking meat on skewers over coals to use of nails in meat cooked on stove.

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[48] In commenting on the manuscript Dr. Margaret Mead mentioned the absence of the folk idea of "goodness" important in English and American cooking. According to her, there is a belief that there is especial essence of the food called "goodness" which lives in the skin or under the skin which will be lost by too much cooking, gets thrown away in the cooking water. The idea, she states, takes this sort of form: "All the goodness of the meat goes into the broth, that's why we give broth to the sick," "the goodness of a potato is just inside the skin," "if you peel an apple you lose most of its goodness."

Significance of Traditional Food Preparation Rules for Home Economists

To what extent homemakers of this study still followed food preparation rules taught by mother or someone else in parental home will be shown in a future report. Even though many no longer followed the rules, an analysis such as this has significance for home economists, for it shows:

(1) That older homemakers and homemakers with less schooling, such as Negro homemakers, have more often been taught food preparation rules by their mothers or someone else at home. It would, therefore, seem especially important in working with such groups to learn every thing possible about what the women have been taught and to use this information as a basis for a teaching program. For instance, if it is found that soda is used for tendering vegetables by a number of women in the group, a lesson in vegetable cookery might be started off in the following manner: "I know folks always used to say add a little soda to vegetable to tender . . . ."

(2) Need for examination of all old cookbooks in the area in which group with whom one works resides. (Cookbooks, it must be remembered, are a way of preserving outmoded practices—practices that are actually contrary to modern teaching.) It might be well to establish a museum

of old cookbooks in each county publicizing the fact that these books are relics of the past.

(3) Need for presenting food preparation as a changing body of information. It changes because of: (a) increased nutrition information; (b) development of new techniques in preparation; (c) changes in processing; (d) changes in taste brought about by the introduction of new foods, new dishes, new ideas from other areas.

(4) That even in the case of "scientific" food preparation rules, an attempt is made to commend the practice from a practical basis. This shows the importance of giving practical reasons for every step in preparation.

(5) That source of "unscientific" food preparation practices prevalent in the area in which one is working should be sought and discussed with the group before attempting to change practices.

(6) That since most women who are taught food preparation in turn teach others, techniques in passing on food preparation information are most important in order that directions may not be misinterpreted or misapplied.

(7) Importance of teaching discrimination in choice of food preparation information.

(8) This study suggests that at the beginning of training in vegetable preparation or meat preparation, it might be well to have students write essays on "What I Have Been Taught at Home About Cooking Vegetables" or "What I Have Been Taught at Home About Cooking Meats." Such material would serve as an excellent background for teaching food courses.

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IMPROVING PASTURES
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MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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INTRODUCTION

Livestock production has increased to a very marked degree in Mississippi during recent years. This increased production trend was most noticeable soon after controlled cotton acreage began in 1933, and is attributed to an attempt by the farmers to offset the decreased acreage and income from cotton. This trend has increased, however, during the past few years probably because of more favorable prices of livestock products. In addition, the scarcity of farm labor has caused farmers to divert more land to the growing of livestock and dairy animals in order to utilize the maximum of their farm land.

Thus, with a considerable increase in production of livestock and dairy animals, there has likewise been an increased demand for feed. Since it is generally agreed that pastures afford some of the cheapest feed to be had, increased livestock production has resulted in an increased demand for pastures, both for increased acreage and for better grazing on pastures already established.

The program of pasture improvement and establishment of new pastures has been accelerated by the fact that the Agricultural Adjustment Administration has extended certain payments for pasture practices such as clearing, seeding, fertilizing, terracing, and mowing; and the acreage on which the payments could be made has been unlimited.

As a result of this increased production of livestock together with the increased demand for pasture improvement practices, there has been a great demand for information from workers in the various agricultural agencies which might be used in teaching farmers and farm boys the probable value of each pasture improvement practice and the extent to which it would be economical to use the practices.

An attempt is made in this bulletin to bring together all the data, especially experimental data, available on pasture practices that seem to be applicable to Mississippi conditions. Since the amount and variety of such data are very limited it was thought that it would be advisable to supplement these data with information on improved pasture practices being used by farmers in the various sections of Mississippi.

Thus, a survey was made on 86 farms in 4 areas of Mississippi; namely, (1) South Mississippi, (2) Northeast Mississippi, (3) the Brown Loam Area, and (4) the Prairie Area. Farmers' reaction as to the value of improved pasture practices was obtained, definite observations were made, and in this way some very definite indications were obtained as to the probable value of the various pasture improvement practices. It is thought that this type of information on farmers' practices will supplement the experimental data in a very helpful way.

A summary of these surveys is shown and discussed in detail by areas and as a whole in Part II of this bulletin. The survey study is also referred to and discussed in part in other sections of this bulletin.

It is hoped that this information will be useful to agricultural workers and, in turn, to farmers of Mississippi, as a guide in helping them to decide the probable value of the various pasture improvement practices and extent to which it might be most economical to use each practice on individual farms.

Improving Pastures In Mississippi

PART I

THE VALUE OF PASTURES IN LIVESTOCK PRODUCTION*

The lowering of the cost of production and the efficiency of production are as important in agriculture as in any other type of industry. In this economic sense, the efficient production of livestock and livestock products is directly related to the production of pastures.

That pasture production plays an extremely important part in the agriculture of Mississippi is shown by the practical results obtained by various departments of the Mississippi Agricultural Experiment Station.

The Dairy Department at Mississippi State College has conducted many tests which show that no other method of providing feed for livestock offers as great returns as the use of good pastures. Pasture made on eroded land was found to furnish nutrients per cow per day, equivalent to those found in 8.5 pounds of good hay, 25 pounds of silage, and 4 pounds of concentrates. Other results obtained by the Dairy Department show that a good pasture alone will provide for animal maintenance and the production of at least 15 pounds of 4 percent milk per cow per day. The matter of maintenance is quite important as a milking dairy cow requires nearly half the nutrients in the feed she consumes merely for maintaining her body. The experimental test below shows the value of good pasture for dairy cattle at State College, Mississippi, from 1924 to 1926.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 4, State College, Mississippi, July 1941.

Value of Pasture for Dairy Cows

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1924-1926.

Purpose: To compare the production of milk cows with and without pastures.

Procedure and conditions: During the summer of 1924, five cows on good pasture were compared with five cows on poor pasture for a period of 168 days. This test was repeated in 1925 with two lots of four cows each for a period of 161 days. The average results of these 2 years preliminary work indicate that a cow on good pasture can secure sufficient feed for maintenance and for the daily production of 14 pounds of milk testing 4 percent butterfat. In 1926, a test was made by dividing 12 cows into 3 lots of 4 cows each. The cows were fed for three periods of 8 weeks each as follows: Lot 1 was on good pasture during the first and third periods and in a dry lot during the second period. Lot 2 was in a dry lot during periods one and three and on good pasture during period two. Lot 3 was on good pasture for all three periods. One week was allowed between each period for making the change from one feed to another. The results of these tests are shown in table 1.

Table 1. Value of pasture for dairy cows, State College, Mississippi, 1924-1926

	Lots 1 and 2 No pasture	Lots 1 and 2 Good pasture	Lot 3 Good pasture
Number cows on test	4	4	4
Days on test	168	168	168
Gain or loss in liveweight	- 27	529	365
Production:			
Milk, pounds	12,142	13,071	13,772
Fat, percent	3.95	3.96	4.58
Fat, pounds	479.5	518.4	631.7
Feed consumed:			
Gain, pounds	4,508	2,114	2,107
Hay, pounds	10,976	------	------

Reference: Mississippi Agricultural Experiment Station Bulletin 259, "Feed, Care and Management of the Dairy Cow," page 13, State College, Mississippi, January 1928.

Value of Pastures for Livestock, Poultry and Erosion Control*

The Animal Husbandary Department, in an experiment comparing methods of feeding mules, has found, when mules were allowed to graze only at night and on idle days, that there was a saving of 25 percent in grain and a 50 percent saving in hay consumed, as compared with the barn and lot-fed mules. These results take on considerable value when one considers that a properly fed, 1,000-pound mule will consume 2 tons of hay and 60 bushels of corn per year.

Other experiments carried on by the Animal Husbandry Department have shown something as to the value of pastures. More pork has been produced per 100 pounds of feed where grain-fed pigs were allowed to graze than when fed on dry lot. It has also been shown that more cottonseed meal, a home-grown concentrate, can be fed to grazing pigs than to pen-fed pigs.

The Poultry Department has found that more eggs are produced, there is less mortality in the flock, and the efficiency of production is increased when poultry is allowed pasturage.

The value of a pasture is almost inestimable when viewed from a soil conservation standpoint. The Agricultural Engineering Department of the Mississippi Station in cooperation with the U. S. Soil Conservation Service conducts experiments testing the rate of soil losses under different slopes and cropping practices. A typical example of the results obtained from these tests may be cited. As a result of 24 inches of rain over a period of 3 months, the amount of soil lost from a 9 percent slope covered with sod was only 0.08 tons per acre, while a crop-cultivated 7.5 percent slope lost approximately 5 tons of soil per acre during the same period and with the same amount of rainfall. This gives a value to pastures which amounts to huge proportions when one considers the average rainfall and the topography of many of the Mississippi pastures.

These examples are given to cite the value of pastures, not only from a general farming standpoint and for the economcial production of livestock and livestock products, but also as a means of stabilizing and utilizing the many eroded and erosive acres of Mississippi soil thus enabling the realization of more income and food products than formerly. These examples show, further, that the general-crops farmer, as well as the livestock farmer, needs good pasture for his milk cows, beef cattle, hogs, poultry, and for his work stock.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 4, State College, Mississippi, July 1941.

PART II

IMPROVED PASTURES

One has but to travel the highways in Mississippi to know that pastures, generally, need improvement. In a large percentage of these pastures can be seen weeds, briars, bushes, and other undesirable plants which greatly hinder the growth of desirable pasture plants.

Farmer practices have shown that such pastures can be improved even where the only practices used were clearing the land of bushes, weeds, etc., and controlling same by mowing regularly. For instance, on the farm of Marshall Rivers at Union, Mississippi, in Neshoba County, a 14-acre pasture was cleared of such growth and mowed twice a year for 2 years, and the carrying capacity was increased from 8 animal units to 18, according to statements of the owner. Results of other practices might be cited on C. C. Harveys' farm, Winona, Mississippi, in Montgomery County. This 65-acre pasture was carrying 30 animal units without any special improvement practices. An application of 1,000 pounds of lime and 500 pounds of basic slag per acre was made. Dallis grass, white Dutch clover, and lespedeza were sown and the pasture was mowed twice a year. About 2 years later it was carrying 65 animal units. These results were obtained on bottomland which was better than average in fertility before it was fertilized.*

Special Study of Pasture Improvement Practices

In order to better determine what can be done in the way of improving pastures in Mississippi under everyday farm conditions, a survey of pasture conditions, improvement practices used, and practical results obtained, was made on 86 Mississippi farms.

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*From reports to the author in making the survey for this publication.

These surveys were made in four general soil areas of Mississippi, namely, South Mississippi, Northeast Mississippi, Brown Loam, and Prairie. The number of farm surveys made in each area varied somewhat according to the number of farms in the area and the amount of experimental data available for the area.

No attempt was made to select the best nor the poorest farms surveyed, but some of all types were selected with the idea of securing a fair cross-sectional sampling for each area; however, in spite of this, some of the better farms were probably surveyed because farmers were selected that had done one or more pasture improvement practices and it is natural to assume that farmers who are interested to the extent that they had done some improvement practices might have been in the better farming group. Too, the farmers surveyed may have better soil than the average farmer, and did have, in most cases, special technical help and guidance in carrying out the practices. It is believed, however, that the improved practices used by these farmers will indicate possible improvements to almost all farmers. For the stated reasons, however, all farmers should not necessarily expect to secure the same results by use of the same practices as are shown in this study.

The survey ascertained all the practices done during the past 5 years as well as the pasture conditions before treatment and at the present, and the approximate results obtained as a result of pasture treatments. An analysis and discussion of this study by soil areas and for all the areas as a whole, follows.

South Mississippi Area

Thirty-two farms were surveyed in seven different counties in this area. The pastures varied in size from 12 to 1,120 acres.

A summary of the surveys from this area is shown in table 2; however, all the conditions, practices, and results are not shown in the summary because some of these were rather indefinite and could not be recorded in actual figures.

Table 2. Summary of pasture conditions, treatments given, and results in carrying capacity in the South Mississippi Area

Item		Number or amount
Number of farms surveyed		32.0
Number of acres per farm in pasture:		
a. Hill land		44.0
b. Bottomland		50.7
c. Terrace land		7.4
d. Total acres		102.1
Average percent slope of hill and terrace land		4.5
Average number acres fertilized and rate of fertilizing:		
a. Lime:	Acres	73.3
	Rate, pounds per acre	866.0
b. Phosphate:	Acres	58.2
	Rate, pounds per acre	155.0
c. Potash:	Acres	1.0
	Rate, pounds per acre	183.0
d. Basic slag:	Acres	20.0
	Rate, pounds per acre	562.0
Average number of acres seeded and rate of seedings:		
a. White Dutch clover:	Acres	42.3
	Rate, pounds per acre	3.6
b. Lespedeza:	Acres	54.0
	Rate, pounds per acre	14.0
c. Yellow hop clover:	Acres	8.3
	Rate, pounds per acre	3.6
d. Dallis grass:	Acres	50.0
	Rate, pounds per acre	10.0
Number of farms on which pastures were mowed		24.0
Acres mowed per farm		84.0
Number of mowings per year		1.5
Number of farms practiced rotational grazing		12.0
Number of acres required per animal before treatment		3.8
Number of acres required per animal after treatment		1.6

As shown in table 2 the average size of the pasture was about 102 acres, 44 of which were hill land, 50.7 bottomland, and 7.4 terrace land.

On the average 3.8 acres of pasture land was required to carry an animal unit before pasture treatments were made and only 1.6 acres were required after treatments. This is an increase in carrying capacity of approximately

140 percent. In other words, the average pasture which was 102 acres in size carried about 30 animal units before treatment and 64 after treatment. This obviously is a good increase in carrying capacity of pastures due to improvement practices; however, the carrying capacity of these pastures was comparatively high before treatments were given. For instance, where 3.8 acres were required to carry an animal unit in the South Mississippi Area, 4.6 acres were required in the Brown Loam Area which is generally considered better adapted to pastures. This might be partially explained by the fact that about half of the pasture land surveyed in South Mississippi was bottomland and the hill land had only a 4.5 percent slope on the average; whereas, only 23 percent of the land in the Brown Loam Area was bottom soil and the average slope of hill land was 8.8 percent, all of which indicates that in South Mississippi, on the farms studied, soils well adapted to pastures were devoted to pastures. The response to treatment, however, seemed to be better in the Brown Loam Area, in that the number of acres required to carry an animal unit after treatments in both areas was very nearly the same.

Practices used in securing this increase in carrying capacity in South Mississippi are as follows: Approximately three-fourth of the land was limed and about half of the land had an application of phosphate but only a small percentage had basic slag. The rate of applying lime and basic slag was comparatively high while the rate for phosphate was low. About half of the pasture land was seeded to white Dutch clover, lespedeza, and Dallis grass. Twenty-four of the 32 farmers mowed their pastures, about 82 percent of the average pasture being mowed an average of 1.5 times per year.

The increased carrying capacity, which, as stated above was from an average of 30 to 64 animal units, is thought not a true indication of the increased value of the pasture, for several reasons. First, when farmers made one or more pasture improvements, many of them would immediately increase the size of their livestock and/or dairy herds, which in a number of cases resulted in over-grazing and low gains as well as poor quality products. On the other hand, some farmers were not over-grazing before treatments were given, and after treatments their pastures would have carried more animals than were carried; while some farmers were over-grazing before any pasture improvements were made and with the same number of animals following improvements, the animals were carried adequately. It might be noted here, that according to observation and experience of agricultural workers contacted in this study, over-grazing hinders the establishment of new grasses and eradicates more grasses and clovers already established in pastures than any other undesirable practice.

No definite part or value of the increased carrying capacity of these pasture practices can be assigned to any particular practice used because in most cases two or more practices were done at the same time with no attempt to determine the value of each one separately. However, it is evident that all the practices together were of definite value. The farmers' reaction, as well as that of the agricultural workers who assisted the farmers, was that the use of the mowing machine gave quicker and greater returns, especially when considered in the light of costs, than any other pasture improvement practice; and the use of fertilizer was probably second in value.

Statements made in the two preceding paragraphs apply equally to the other soil areas discussed in this section and will not be repeated in the discussions for each area.

It should be pointed out that every farmer in South Mississippi should not necessarily expect the same results from pasture improvement practices as shown here, even with the same treatments. One reason for this is that, as already indicated, the pasture land included in the surveys for this area was comparatively good land and probably better than the average in South Mississippi. Many other conditions and factors vary from farm to farm. Yet, these results do indicate that improved practices adapted to each individual would result in better pastures in every case. Thus, it is suggested here that each farmer estimate the cost and value of treatments for his individual farm, taking into consideration his conditions, situations, etc. These estimates may be somewhat on the basis of the summary shown in table 2. It would be easy to calculate the cost of the practices shown in this table which would apply to any farm in the South Mississippi Area if the same practices were anticipated; however, the returns expected would probably vary and could easily be less than shown here for reasons already given. The form shown in table 15 might be of value in helping individual farmers estimate the cost of pasture practices, returns expected, and in trying to determine the practices and the extent of each practice to be used.

Northeast Mississippi Area

Twenty farms were surveyed in four different counties in this area. The size of the pastures varied from 6 to 72 acres, the average being 32.3 acres. A summary of these surveys is shown in table 3.

As shown by figures in the table, 2.5 acres were required to carry an animal unit before the above treatments were given the pastures and only 1.4 acres after these treatments were given. Thus, the average pasture of 32.3 acres in this area carried almost 13 animal units before treatment and about 23 head after treatments were made. The percentage increase in carrying capacity here is not so great, comparatively speaking; however, the carrying capacity of the pastures was high before any treatments were made. This is probably due to the fact that the pasture land in this area, on the average, was fairly high in fertility, a probability borne out by the fact that only about 30 percent of the pasture land in this area was upland. Since a high percentage of the pasture land was in the bottom, it is reasonable to suppose that it was better than average land, and thus the chances for increased production due to use of improvement practices were less than if the land had been less fertile. Another factor indicates that even the better hill soils were in pasture, in that the average slope of the hill land was only 4.2 percent. It might be pointed out here that the carrying capacity of pastures before any treatments were given was higher in this area than in any other studied. Thus, in the light of the high carrying capacity of these pastures before any treatments were given, the increase due to pasture treatments was favorable.

Summarizing the practices used in securing these improvements it should be noted: (1) A high percentage of the land had an application of phosphate and basic slag and the rate was in line with generally accepted practices. (2) About one-third of the land was limed, although the rate of application was comparatively low. (3) About half of the land was seeded to white Dutch clover, lespedeza, and Dallis grass. (4) Eighteen of the 20 farmers mowed

Table 3. Summary of pasture conditions, treatments given, and results in carrying capacity in the Northeast Mississippi Area

Item		Number or amount
Number of farms surveyed		20.0
Number of acres per farm in pasture:		
a. Hill land		9.8
b. Bottomland		12.9
c. Terrace land		9.6
d. Total acres		32.3
Average percent slope of hill and terrace land		4.2
Average number of acres fertilized and rate of fertilizing:		
a. Lime:	Acres	11.8
	Rate, pounds per acre	402.0
b. Phosphate:	Acres	18.2
	Rate, pounds per acre	275.0
c. Potash:	Acres	3.6
	Rate, pounds per acre	83.0
d. Basic slag:	Acres	8.9
	Rate, pounds per acre	458.0
Average number of acres seeded and rate of seeding:		
a. White Dutch clover:	Acres	16.0
	Rate, pounds per acre	3.2
b. Lespedeza:	Acres	18.5
	Rate, pounds per acre	10.5
c. Yellow hop clover:	Acres	----
	Rate, pounds per acre	----
d. Dallis grass:	Acres	19.9
	Rate, pounds per acre	10.0
Number of farms on which pastures were mowed		18.0
Acres mowed per farm		28.0
Number of mowings per year		2.0
Number farms practiced rotational grazing		13.0
Number of acres required per animal before treatment		2.5
Number of acres required per animal after treatment		1.4

their pasture twice a year, and approximately 90 percent of the pasture land was mowed. (5) Thirteen farmers practiced rotational grazing. The treatments given were in line with what has been considered generally as accepted practices. In fact, the percentage of land phosphated and the rate of application was unusually high. Noxious weeds were well controlled and the pastures were exceptionally good.

Every farmer in Northeast Mississippi should not expect the same results from pasture improvement practices as are shown in this summary because about half of the surveys made in this area were made in Lee County, and the soil in this county, on the average, is probably more fertile than in some other counties in this area. Too, the farmers in this county are more intensively engaged in dairying than in most of the other counties in Northeast Mississippi which probably has increased the incentive for building better pastures. However, the figures in this study indicate that most any farmer might expect favorable results, on the average, by use of good pasture practices, but it is suggested here that each individual farmer estimate as closely as possible the cost of anticipated practices and the probable returns. Figures shown in table 3 and the suggested form in table 15 should be helpful to farmers in making these estimates.

Brown Loam Area

Twenty-three farms were surveyed in four different counties in this area. The size of the pastures varied from 17 to 900 acres, the average being 131 acres. A summary of these surveys is shown in table 4.

According to the table 4.3 acres of pasture land was required to carry an animal unit before any pasture treatments were made and only 1.6 acres were required after treatments were made. Therefore, the average pasture in this area, which was 131 acres in size, carried about 30 animal units before pasture treatments were given and about 80 head after treatments. These figures show an unusually good increase in carrying capacity which was presumably a result of pasture treatments shown in this survey. However, the acreage required to carry an animal unit before treatments was higher than in any of the other areas. This is probably due, principally, to the fact that only 25 percent of the pasture land was bottomland compared to about 50 percent in South Mississippi, 40 percent in Northeast Mississippi, and 20 percent in the Prairie Area. In addition, the slope of the hill land in this area was 8.8 percent, which was much higher than in any other area. At the same time, the carrying capacity after pasture treatments were made was comparatively high.

Table 4. Summary of pasture conditions, treatments given, and results in carrying capacity in the Brown Loam Area

Item			Number or amount
Number of farms surveyed			23.0
Number of acres per farm in pasture:			
a. Hill land			102.0
b. Bottomland			29.0
c. Terrace land			----
d. Total acres			131.0
Average percent slope of hill and terrace land			8.8
Average number acres fertilized and rate of fertilizing:			
	a. Lime:	Acres	96.8
		Rate, pounds per acre	912.0
	b. Phosphate:	Acres	92.3
		Rate, pounds per acre	282.0
	c. Potash:	Acres	----
		Rate, pounds per acre	----
	d. Basic slag:	Acres	57.8
		Rate, pounds per acre	535.0
Average number of acres seeded and rate of seeding:			
	a. White Dutch clover:	Acres	66.1
		Rate, pounds per acre	5.2
	b. Lespedeza:	Acres	65.2
		Rate, pounds per acre	14.3
	c. Yellow hop clover:	Acres	46.6
		Rate, pounds per acre	1.8
	d. Dallis grass:	Acres	63.0
		Rate, pounds per acre	10.5
Number of farms on which pastures were mowed			21.0
Acres mowed per farm			123.0
Number of mowings per year			2.0
Number farms practiced rotational grazing			16.0
Number of acres required per animal before treatment			4.3
Number of acres required per animal after treatment			1.6

The exceptional increase in carrying capacity of the pastures in the Brown Loam Area was probably due, in the main, to the fact that practically all the land had either an application of phosphate and lime or basic slag, and the rate of application was as high or higher than recommended by pasture specialists. It might be noted here that the rate of applying phosphate and lime was higher in this area than either of the other three areas studied. Another probable effective factor in the marked improvement of these pastures was that practically every farmer mowed his pasture twice each year to control undesirable plants. Other treatments which contributed to some extent were that more than half of the farmers practiced rotational grazing, about half of the land was seeded with plants generally recommended for this area, and seedings were made, at recommended rates.

Since the percentage of improvement was greater in the Brown Loam Area than in any other area in spite of the fact that, as shown above, a larger part of the pastures was hill land and of steeper slope, the survey data seem to indicate that Brown Loam soils are particularly adapted to pasture plants and that they respond well to good pasture practices.

It should be pointed out here, also, that every farmer in the Brown Loam Area should not expect the same results as shown in table 4, even if they use the same practices. On the other hand, it would be better for each farmer to calculate the cost of each practice which might be done on the basis of figures shown in table 4. Of course, the returns could be estimated on the basis of the figures shown in the same table; however, it would be best for each farmer to estimate the returns as well as the cost on his particular farm. The form suggested in table 15 of this bulletin might be used in calculating and estimating costs and returns of pasture improvement practices.

Prairie Area

Only eleven farms were surveyed in this area, which was fewer than in any of the other areas. The size of the pastures varied from 2 to 145 acres, or an average of 55.7 acres. A summary of these surveys is shown in table 5.

Table 5. Summary of pasture conditions, treatments given and results in carrying capacity in the Prairie Area

Item		Number or amount
Number of farms surveyed		11.0
Number of acres per farm in pasture:		
a. Hill land		44.7
b. Bottomland		11.0
c. Terrace land		----
d. Total acres		55.7
Average percent slope of hill and terrace land		3.2
Average number acres fertilized and rate of fertilizing:		
a. Lime:	Acres	3.5
	Rate, pounds per acre	761.0
b. Phosphate:	Acres	38.8
	Rate, pounds per acre	233.0
c. Potash:	Acres	7.5
	Rate, pounds per acre	200.0
d. Basic slag:	Acres	9.5
	Rate, pounds per acre	576.0
Average number acres seeded and rate of seeding:		
a. White Dutch clover:	Acres	22.2
	Rate, pounds per acre	3.0
b. Lespedeza:	Acres	25.8
	Rate, pounds per acre	21.5
c. Yellow hop clover:	Acres	20.2
	Rate, pounds per acre	3.0
d. Dallis grass:	Acres	3.1
	Rate, pounds per acre	17.0
Number of farms on which pastures were mowed		9.0
Acres mowed per farm		49.0
Number of mowings per year		1.7
Number farms practiced rotational grazing		6.0
Number of acres required per animal before treatment		2.4
Number of acres required per animal after treatment		1.7

According to the table, 2.4 acres was required to carry an animal unit before pasture treatments were made, whereas 1.7 acres were required after treatments were made. For the average farm surveyed in this study, this means that the average pasture of 55.7 acres carried about 23 animal units before treatments and 33 animal units after treatments, or an increase of about 43 percent in carrying capacity. This increase in carrying capacity is smaller than in any of the other areas although it is about the same as the increase in Northeast Mississippi. There are probably several reasons why this increase is comparatively small. First, the land devoted to pasture seems to be some of the better land on the farms. As shown in table 5, only 11 acres or about 20 percent of the land was bottomland; and even though the remaining 80 percent was hill land, it only had about a 3.2 percent slope which indicates that this land was some of the better hill land on the farms. This is further borne out by the high carrying capacity of the land before treatment. Another factor which is not shown in the summary is that, from observations and contacts with agricultural leaders in these areas, the pastures were not over-grazed as much in the Prairie Area as in some areas. Thus, these pastures might have supported more animal units and still not have been over-grazed.

It is interesting to note the practices used in securing the above results. Phosphate and basic slag were applied on a very high percentage of the land and the rate of application was also high. White Dutch clover, lespedeza, and yellow hop clover was sown on over half of the land and the rate of seeding was comparatively heavy. Also, from observation made, undesirable plants were apparently well controlled, and the figures in table 5 show that 9 of the 11 farmers mowed 90 percent of the land an average of 1.7 times per year.

It seems to be the consensus among farmers and agricultural leaders in this area that fertilizer is very important to the production of good pastures, especially phosphate, and on some soils, lime and potash are giving good results also. It is also their reaction that the mowing machine for the control of undesirable weeds is very profitable but that seeding is not as necessary, especially on the black lands. The prairie soils seem to be particularly adapted to the growing of desirable pasture plants. Many of the desirable plants are already well distributed, if other conditions are made favorable they come in naturally in a short time.

Every farmer in the Prairie Area would not be justified in expecting the same results by use of the practices shown in table 5. As mentioned before in this bulletin, so many factors vary from farm to farm such as fertility of soil, type of soil, etc., that the percentage increase might be even more or less than is shown here. Nevertheless, it is suggested here that each farmer estimate the cost of pasture practices anticipated and probable returns which may be done somewhat on the basis of figures shown in the table above. A suggested form for making these estimates is shown in table 15.

Weighted Average of the Four Areas Combined

Eighty-six farms were surveyed in the four different areas, the summary of which is shown below in table 6.

Table 6. Summary of pasture conditions, treatments given, and results in carrying capacity in the four soil areas combined

Item		Number or amount
Number of farms surveyed		86.0
Number of acres per farm in pasture:		
a. Hill land		51.7
b. Bottomland		32.2
c. Terrace land		4.9
d. Total acres		88.8
Average percent slope of hill and terrace land		5.5
Average number acres fertilized and rate of fertilizing:		
a. Lime:	Acres	57.0
	Rate, pounds per acre	863.0
b. Phosphate:	Acres	55.0
	Rate, pounds per acre	227.0
c. Potash:	Acres	2.0
	Rate, pounds per acre	151.0
d. Basic slag:	Acres	26.0
	Rate, pounds per acre	538.0
Average number of acres seeded and rate of seeding:		
a. White Dutch	Acres	40.0
clover:	Rate, pounds per acre	4.2
b. Lespedeza:	Acres	44.0
	Rate, pounds per acre	14.3
c. Yellow hop	Acres	18.0
clover:	Rate, pounds per acre	2.2
d. Dallis grass:	Acres	40.0
	Rate, pounds per acre	10.2
Number of farms on which pastures were mowed		72.0
Acres mowed per farm		76.9
Number of mowings per year		1.8
Number farms practiced rotational grazing		47.0
Number of acres required per animal before treatment		3.7
Number of acres required per animal after treatment		1.6

These figures may not be significant since the soil type, fertility, and other conditions vary widely in the different soil areas studied. On the other hand, farmers might be interested in comparing all of these factors along with pasture treatments and results obtained in their particular area to those for the four areas combined.

The above table shows that the average size of pasture on the 86 farms studied was 88.8 acres; and that 3.7 acres were required to carry one animal unit before improvement practices were used, whereas, after treatments only 1.6 acres were required. In other words, the average farm carried 24 animal units on 88.8 acres before treatments and about 55 after treatments, which is an increase of approximately 130 percent. This is an exceptionally high increase in carrying capacity by the use of pasture improvement practices and it is improbable that such favorable results could be obtained on every farm. Yet these results do indicate improved practices adapted to each individual farm.

It is interesting to examine the practices used in bringing about these exceptional results as well as the conditions that may be contributive to same. First, the soil type was probably an important factor in that only about 42 percent of the land was terrace (second bottom) and bottomland which means that approximately 58 percent of the land was upland. Since upland soils, on the average, are less fertile than bottom and second bottom soils, the chances for improved production due to the use of fertilizers were much greater. Even though the study shows that the percentage improvement as a result of improvement practices was greater on upland or thinner soils, the best pastures were found on the better or more fertile soils. This was true before improvement practices were used as well as after they were used. Over 60 percent of the land was treated with lime and phosphorus and about 30 percent was treated with basic slag. The rate of application for the three elements was about the amount that has been recommended generally by pasture specialists in the past. About half of the land was seeded to white Dutch clover, lespedeza and Dallis grass, while less than 20 percent was seeded to yellow hop clover. In addition, about 88 percent of the pasture land was mowed an average of 1.8 times per year, and 47 of the 86 farmers practiced rotational grazing. It can be seen from the figures on fertilizer practices in table 6 or from figures just quoted above, that, in reality, practically all the land surveyed had had one or more applications of some kind of fertilizer. Usually where basic slag was applied, no lime or phosphorus was used unless applied the following or in subsequent years. On the other hand, if lime and phosphorus were applied, and they usually were applied together, basic slag was not used on the same land the same year. Therefore, since it is shown that about 60 percent of the land was treated with lime and phosphorus and 30 percent with basic slag, this would indicate that about 90 percent of the land had phosphorus and lime applied in one form or another; however, this is not literally true because in a few cases lime and phosphorus was applied one year and in subsequent years basic slag was applied on the same land and vice versa.

In summarizing, it would possibly be safe to say that 75 to 80 percent of the land was fertilized and almost half of it was seeded to a regular pasture mixture. Almost 90 percent of the land was mowed about twice a year. All in all, the practices used by the 86 farmers surveyed seem to be well in line with what have been considered good pasture practices, and apparently they were effective from the results secured insofar as the results can be measured from figures shown. It has already been mentioned in this bulletin that the increase in carrying capacity shown in this study does not mean that the pastures increased in value to the same extent because the values of the pastures in terms of gains or production before treatments as well as after treatments are not known. Thus, the results here are more or less approximate and indicative but it can safely be said that there was a pronounced improvement in the pastures as a result of these pasture improvement practices.

Pasture Improved by Fertilizing and Seeding

The 2-acre pasture shown in the picture below belongs to Vivian Carter, Louisville, Mississippi.

This pasture had 5 tons of lime and 1 ton of 4-8-8 applied to it in the spring of 1940 and was seeded with white Dutch clover, yellow hop clover, lespedeza, and Dallis grass.

During the grazing season of 1941, an average of five to six head of livestock was carried on each acre of this pasture.

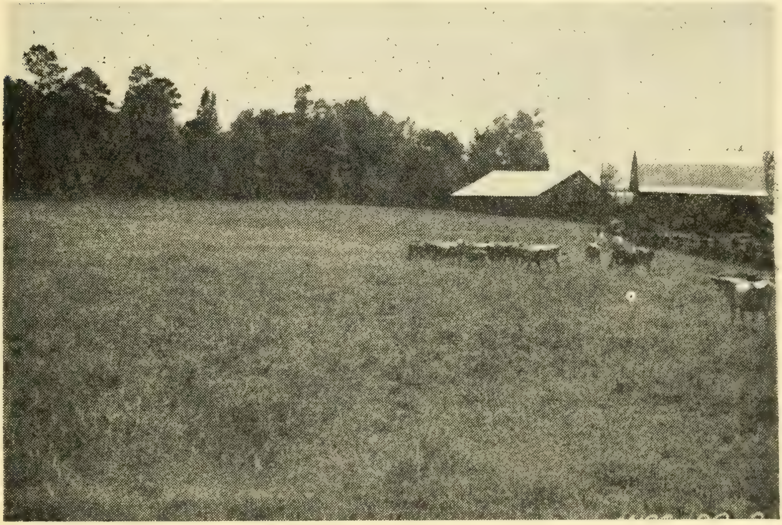

Figure 1. White Dutch, hop clover, lespedeza, and Dallis grass pasture, Vivian Carter Farm, Louisville, Mississippi

Experimental Results on Pasture Improvement Practices

Tests from various agricultural experiment stations comparing the value of improved to unimproved pastures are shown here. This information is unlike the survey study above, in that the results are measured in pounds of products produced and the tests were run mostly in other states. However, they are similar to the survey in that no certain value can be assigned to any particular pasture practice. All the improvement practices needed, in most cases, were used at the same time.

Permanent Pastures for Dairy Cattle

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: S. B. Hartsell farm, Claiborne Parish; N. E. Moncrief farm, Lincoln Parish; B. E. Alford farm, Washington Parish.

Period: 1937-1940.

Purpose: To show what the added returns would be from improved over unimproved permanent pastures on Louisiana dairy farms, and was not a test to determine the actual fertilizer treatment necessary for best results.

Soil: Claiborne Parish—Norfolk sandy loam.

Lincoln Parish—Ruston very fine sandy loam.

Washington Parish—Cahaba sandy loam.

Procedure and conditions: Each test pasture was divided into halves, and each half was treated alike except that one received fertilizer and the other did not. The fertilized half received a complete fertilizer (4-12-4) at the rate of 350 pounds per acre during October or early November of each year. In addition, 50 pounds of nitrate of soda per acre were applied during May of each year. The amount and kind of fertilizer used was not considered the very best for each particular pasture. There was evidence, however, that each test area had soils deficient in both phosphorus and nitrogen, and possibly potash. Also, previous work in the State had shown that best results were secured when all three major plant food elements were applied at the approximate rate used in this test. Two of the three test areas received applications of limestone to correct the soil acidity. Details regarding the amounts used as well as the time applied will be given under the discussion of individual tests.

Test pastures, including those not fertilized, were seeded to clovers and Dallis grass. The clovers included white Dutch, hop, and bur. Annual fall seedings of either oats or rye grass were made for 2 years on one test and for 3 years on another. Weeds were controlled by two or more mowings each year. Producing Jersey cows grazed each test pasture and were rotated between pasture areas in order to graze the fertilized and unfertilized halves to the same degree of closeness.

A good idea of the benefits obtained from improving permanent pastures can be derived from the 4-year average results secured from the three tests located in widely scattered dairy sections of the State of Louisiana, which are shown in tables 7, 8, and 9.

Table 7. Yearly grazing days, all tests; Louisiana, 1937-40

	1937	1938	1939	1940	4-year average
No. days grazed, unfertilized	56	72	75	79	70
No. days grazed, fertilizer	83	99	123	137	110
Cow days per acre, unfertilized*	101	114	121	171	127
Cow days per acre, fertilized*	158	164	212	266	200

*Days grazed × average number cows ÷ number acres = cow days per acre.

Table 8. Yearly milk production per acre, all tests; Louisiana, 1937-40

	Pounds of milk produced per acre				
	1937	1938	1939	1940	4-year average
Unfertilized plot	1827	2225	2092	3226	2342
Fertilized plot	3138	3195	3722	5350	3851
Percent increase	72	44	78	66	64

During late May and October of each of the 4 years, hay was harvested from protected areas of the test pastures. This was done in order to secure a check on grazing results and to determine the effect fertilization had on the mineral content of the herbage.

The results of this check are shown in table 9.

Table 9. The effect of fertilization on the yields and phosphorus content of hay

	Year				
	1937	1938	1939	1940	Average
Yield of air-dry hay per acre:					
Unfertilized pasture, tons	.95	1.35	1.61	2.80	1.68
Fertilized pasture, tons	1.51	1.32	2.69	3.27	2.20
Average increase of fertilized plot, percent					31.00
Percent phosphorus in hay:					
Unfertilized	.37	.43	.47	.54	.45
Fertilized	.42	.86	.38	.63	.56
Average increase of fertilized plot, percent					24.00

In the fall of 1940, basic slag was applied at the rate of 600 pounds per acre to the previously unfertilized half of each test pasture. The halves receiving the annual application of 4-12-4 and nitrate of soda were treated the same as in the past, with the exception of one test (Hartsell), in which case no fertilizer was applied.

The added response from the previously unfertilized halves as compared to the 4-year averages for the test pastures is shown in table 10.

Table 10. The 1941 response of pastures receiving basic slag compared to the 4-year yield of fertilized and unfertilized pastures, average of three tests

Unit of measurement	Fertilized*		Unfertilized 1937-1940 Basic slag in 1941	
	Av. yield per acre, 1937-40	1941 yield per acre	Av. yield per acre, 1937-40	1941 yield per acre
Cow days grazing per acre	200	270	127	204
Increase over 4-year average, percent	------	35	------	61
Pounds milk per acre	3,851	4,884	2,342	3,915
Increase over 4-year average, percent	------	27	------	67

*One of the fertilized pastures did not receive its usual application of fertilizer for the 1941 season, but had been regularly treated for the previous 4 years.

Reference: Louisiana Agricultural Experiment Station Bulletin 341, "Profitable Permanent Pastures for Dairy Cattle," pages 3, 4, 5, 6, 7, 13, and 14, tables 1, 2, 3, and 7, March 1942.

Improved Versus Unimproved Pastures

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Test I, Experiment, Georgia; Test II, Jonesboro, Georgia.

Period: 1941.

Purpose: To compare the results with beef breeding cattle on improved and unimproved pastures.

Soil: Cecil.

Procedure and conditions: Test I—Improvement of several pastures in 1936 consisted of applying limestone and fertilizers and seeding pasture legumes on bermuda sod. After several years of excellent and increasing production of the improved pastures, the stand of clovers (white

Dutch, black medic, subterranean) seeded in 1936 was replaced by hop clover, and production in general would have declined if commercial nitrogen fertilizer had not been applied on the summer-growing bermuda grass in 1940 and 1941. A second application of limestone and of phosphate was not sufficient treatment to bring back the more desirable clovers, but a seeding of Ladino clover in the fall of 1941, along with somewhat favorable weather conditions, is once more bringing the improved pastures into their former high state of productiveness. In contrast to the

Table 11. Grazing results obtained with four beef breeding herds on two improved and two unimproved pastures; Georgia, 1941

	Project VII		Project VI	
	Improved pasture	Unimproved pasture	Improved pasture	Unimproved pasture
Date placed on pasture	Apr. 30	Apr. 30	Apr. 23	Apr. 25
Date removed from pasture	Oct. 28	Oct. 1	Oct. 29	Oct. 22
Number of days on pasture	149	122	189	152
Number acres in pasture	14.52	15.19	8.0	27.0
Average number of cows on pasture	14.0	7.0	7.8	12.9
Average number of calves on pasture	6.1	4.9	4.3	10.5
Carrying capacity, number of 1,000 pound cow-equivalents per acre	0.89	0.44	1.12	0.55
Actual cow-days of grazing obtained per acre	143.7	56.2	186.1	72.6
Number of 1,000-pound cow-equivalents of grazing per acre[1]	132.6	53.7	211.7	83.6
Average weight of cows at start, lbs.	707.3	773.5	890.0	799.5
Average weight of cows at end, lbs.	825.4	807.9	996.0	893.0
Average gain per cow, lbs.	118.1	34.0	106.0	93.5
Average daily gain per cow, lbs.	0.89	0.78	0.52	1.01
Number of live calves produced 1940-41 season	9	5	4	12
Percent live calf crop	64.3	71.4	57.1	100.0
Average daily gain per calf, lbs.	1.02	1.21	1.61	1.59
Gain in weight of calves, per acre, lbs.	71.9	42.0	182.5	104.2
Gain in weight of cows, per acre, lbs.	127.4	44.0	95.5	73.0
Gain in weight of cows and calves, per acre, lbs.	199.3	86.0	278.0	177.2

[1] These figures do not include calves.

improved pastures, the unimproved pastures declined most in productiveness in the first few years of this experiment. Steers were used to graze some of these pastures the first several years but breeding cows and calves have been the experimental animals on these pastures from 1939 until the present. Results obtained on these pastures in 1941 are given in table 11.

Test II—In pasture No. 1, 3 acres out of the 10 received a lespedeza seeding instead of clover, and received only half as much phosphate as the remaining 7 acres of clover in order to discourage clovers from coming into the lespedeza. In pasture No. 2 all 10 acres were seeded to clover, and the only lespedeza present is that which survived the winter clover competition.

Fertilizer was applied as follows: Limestone at the rate of 1,580 pounds; 600 pounds 16 percent phosphate on clovers and 300 pounds on lespedeza and 400 pounds soda per acre.

Some grazing was obtained on all pastures during the winter months, November through January. Results of Test II are shown in table 12.

In the second year of this experiment (1941) much better cattle gains were obtained than in 1940, especially on the improved pastures and more so on the bottomland than on upland areas. This is typical of pasture improvement effects because as the clover stand and growth improve, the grass sod is thickened up and the amount of grass

Table 12. Cooperative pasture improvements,—Helmer Farm Jonesboro, Georgia, 1941

	Pasture Number									
	1	2	3	4	5	6	7	8	9	10
Location, upland or bottom	Upland	Upland	Upland	Upland	Upland	Upl & Bottom	Bottom	Bottom	Bottom	Bottom
Fertilizer treatment:										
Lime, pounds	1580	1580	1580	—	—	1580	1580	1580	1580	—
Phosphorus, pounds	96	96	96	—	—	—	96	96	96	—
Nitrogen, pounds	—	—	64	—	—	—	—	—	—	—
Predominating species[1]										
White clover-Bermuda	x	x	x	—	—	x	x	x	x	—
Lespedeza-Bermuda	x	—	x	x	x	x	x	x	x	x
Steer gains:										
Per acre of pasture, pounds	141	122	170	117	87	210	280	233	222	233
Av. daily per steer, pounds	1.12	1.13	.99	1.36	1.15	1.23	1.31	1.16	1.08	1.33
Steer-days grazing per acre	126	108	171	86	75	170	214	201	206	175

[1] Other species were seeded on certain pastures but failed partly or entirely—crimson and hop clovers on pasture No. 4, Dallis grass on No. 9, carpet grass on Nos. 7 and 10. An x signifies presence of, and a dash absence of species.

growth is also increased, both factors thus being instrumental in increasing cattle gains.

The outstanding difference shown by table 12 is the much greater cattle gains obtained on the bottomland (242 pounds per acre) as compared to upland pastures (average 123 pounds per acre). The greater cattle gains were produced on bottomland both because of the higher carrying capacity and longer grazing season. These two factors are combined in "steer-days of grazing" per acre, which amounted to 199 on bottomland pastures (average of 4) and 113 on the upland pastures (average of 5). Pasture No. 6, which is part upland and part bottomland, produced 210 pounds of steer gains and provided 170 steer-days of grazing, thus placing this pasture between strictly upland and strictly bottomland in productiveness. This indicates that under normal farm conditions considerable increased cattle production can be obtained if some bottomland is combined with upland pasture.

In addition to greater cattle gains on bottomlands than on uplands, more crimson and white Dutch clover seed were harvested on the bottomland and there was sufficient excess growth from grass in the summer that hay and grass for silage was also obtained on bottomland pasture. The exact amounts of seed saved and hay and silage obtained on the pastures are not given in the reference used; however, the values are given but are not shown in table 12. However, crimson clover seed were valued at 6 cents, white clover seed at 75 cents per pound, and hay and grass silage at $10 per ton, and on these price assumptions the value of clover seed, hay and silage obtained on bottomland pastures was as great or slightly greater than the value of steer gains produced on most of the upland pastures, valuing beef at 8½ cents per pound.

Reference: Georgia Experiment Station Report for 1941-42, pages 58-62 inclusive, tables 36 and 37, Experiment, Georgia.

Improved Versus Native Pasture

Conducted by: Texas Agricultural Experiment Station, College Station.

Conducted at: Angleton, Texas.

Period: 1934-37.

Purpose: To compare native and improved pasture for fattening steers.

Land history: The area was natural prairie land which had been a native hay meadow for a number of years previous to being plowed and seeded to improved pasture grasses.

Soil: The soil was Lake Charles clay loam and Edna very fine sandy loam with salt spots. The land was almost level, with fair, but slow drainage, and was not eroded.

Procedure and conditions: The improved pasture consisted of about an equal mixture of dallis, bermuda, and carpet grasses with some Angleton grass and volunteer native grasses. Lespedeza and white Dutch clover were also present. In the spring of 1931 the land was flat-broken, disked, then the seed was broadcast and harrowed in. No fertilizer was applied.

The native pasture consisted largely of little bluestem with some big bluestem, bush bluestem, a small amount of carpet and bermuda grasses, and a considerable amount of native weeds such as milkweed, ragweed, myrtle bushes, and sulphur weed.

The same pastures were used each year.

Seven steers were grazed on 17.5 acres of improved permanent pasture without supplementary feed, while seven other steers which were grazed on 17.5 acres of native pasture required a supplement of prairie hay from January to March each year.

The cattle were grade Hereford yearling steers at the beginning of the experiment, and were in fair range condition. They were pastured continuously throughout the year. A shed was provided in each pasture.

Reference: United States Department of Agriculture, Agricultural Adjustment Administration Bulletin SRAC-5, "Permanent Pastures," page 27, table 18, Washington, D. C., June 1938.

Table 13. Gains made by steers on improved and native pastures, Angleton, Texas, 1934-37

Item	Unit	Improved pasture	Native pasture
Steers per lot	number	7	7
Total days grazing	do	1,305	1,154
Average initial weight	pounds	485	485
Total gain per steer	do	525	358
4-year average gain per steer[1]	do	131	90
Sale price per 100 pounds[2]	dollars	$ 6.25	$ 6.35

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[1] Calculated by the Southern Division, A.A.A.

[2] Steers on native pasture were sold in June 1937 and those on improved pasture were sold in November 1937. The market price on medium to common grade steers was from $1.50 to $2.00 per hundred pounds lower on November 15, 1937, than on June 16, 1937.

Improving and Maintaining Pasture Land in Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1930-1939.

Purpose: To determine the labor and cost of improving and maintaining permanent pasture.

Procedure and conditions: Several years prior to the starting of this test 6 acres of land on rather steep hill side and unsuitable for cultivation was stopped of gullies, fertilized with 12.5 tons barnyard manure per acre, and planted to grasses and clovers for pastures for which it was well suited. At the time this project was started there was a good sod of grasses and clovers and it would have been called a good pasture. This was set aside to be used as a pasture for the dairy cows. During the 10 years of the experiment an average of 2.6 tons of barnyard manure was applied each year.

Four cows, or one cow for each 3½ acres of pasture and cropland, were originally selected. This provided only 1½ acres of pasture per cow, which would have been insufficient except for the fact that several years had been spent in making this 6 acres a good pasture. Due to this and further improvement of pasture land throughout the experiment, it was possible later on to increase the number of cows from four to six, so that the average pasturage per cow for the 10 years was 1.25 acres. This area furnished pasture for an average of 257 days per year.

Table 14. Maintaining a 6-acre pasture for 10 years, Mississippi, 1930-1939.

	Hours labor on pasture			Cost*	
	Man	Horse	Tractor	Dollars	Cents
Labor:					
Hauling and spreading manure	460.0	920.0	......		
Seeding, 106 lbs. white clover	8.0	......	......		
Mowing	58.2	114.8	1.8		
Terracing	10.8	10.0	0.8		
Fencing and repairs	59.5	......	......		
TOTAL HOURS	596.5	1044.8	2.6		
Cash costs:					
26 tons manure	......	......	......		
106 lbs. white clover	......	......	......		
Other	......	......	......		

*The cost column is left blank so that all costs may be calculated on the basis of current local prices.

Cows for this experiment were chosen from the college dairy herd, representing as nearly as possible the average cow in the herd. When it was necessary to replace any animal or add others the same policy was followed.

Reference: Mississippi Agricultural Experiment Station Bulletin 343, "The Place of Dairying in Mississippi," pages 3, 4, 5, 6, table 2, State College, Mississippi, May 1940.

PART III

PASTURE LAND

Selecting Land for Pastures

The question of what land to use for pasture is one of the most critical pasture problems confronting Mississippi farmers. Too, this problem varies widely from farm to farm, and from one soil area to another in the State. Some of the prevalent situations which present this question as a definite problem are:

Bottom or Hill Land

In some areas of the State the bottomland is very poorly drained and consequently is ill adapted to tilled crops. On many farms such land has been cleared and cropped for a time. Farmers may even be still attempting to crop it but the risk of crop failure is great. Where such conditions exist the best use of such land is usually grass, either pasture or hay, or some of both. In this kind of situation it would probably be best to use hill land for crops and bottomland for pasture and hay for livestock.

Moisture

Closely related to the question of hill and bottomland for pasture is that of the effect of moisture on good pasture. Because bottomlands usually hold moisture longer during critical periods, they make better pasture than hill land. This is not to say that there is not much good hill pasture land in the State. Here again, the susceptibility of hill land to drouth is a major factor in the pasture possibilities of such land. Thus, generally speaking, dry sandy hill soils are not as well adapted to pasture development as bottom soils.

Competition with Other Uses for the Same Land

If cattle farming (dairy or beef) were the most profitable use of land in Mississippi, generally, or on any particular farm, then the answer to the question of what land to put in pasture would always be the land that will produce the best pasture. Often this best pasture land is also the best land for cotton or some other crop. Under such conditions one must decide which is the most profitable way to use this dual purpose "best" land. If the most profitable use is some other crop, then on such a farm it is best to grow the maximum amount of such crop. It may be that a farmer on such land may not have enough labor to put all his best land in this most profitable crop and, in this case, his whole farm business may be improved by using some of this best land for pasture. During critical labor shortage periods, like war times, it may be most profitable to divert much good land (such as cotton land) to pasture and livestock which do not require much labor.

It is very important that one figure carefully what is the most profitable farm business as a whole when considering how much "best" land to put into pasture.

On Small Farms

Many small farmers are utilizing practically all their open land in the production of crops from which the returns per acre are greater than that which could be derived from livestock. On such farms the question of what land, if any, for pasture is most critical. Such farms are usually worked with the family labor and consequently labor in proportion to land is not a problem. Usually on such farms the pasture question resolves into the value of pasture to the farm workstock, the family milk cows, and all other livestock consumed on the farm. While there may not be a clear-cut answer based on experimental information to the question of what to do about pasture on such farms, it is believed that the best thing to do on such farms is to take a limited area of the best pasture land on the farm and by applying intensive methods of improvement, such as seeding and fertilizing, make the very best possible pasture. It is believed that this will result in better workstock that are more economically fed; better family milk cows that are better fed and give more milk; more and cheaper meat (pork and beef) for family use; and probably a better income from the farm as a whole.

Farm with Idle Land

The idle land on thousands of farms in Mississippi will run from a few acres to more than half the acreage of the farm. On such farms, the selection of land for pasture has to do with the possibility of increasing the total returns from such farms by utilizing this heretofore unutilized land in pasture. Often much of this land is not in a condition that is adaptable to intensive pasture improvement. In the most practical sense, the question here is whether to use this land for pasture or not use it? On this land will usually be found some soil that is fertile and well adapted to pasture and can be developed by some clearing, mowing and possibly seeding, while there may be some other land on the same farm on which it would not be economical to establish pastures.

Selection of otherwise unutilized land for pasture and making improvements that are practical under existing conditions, should receive careful consideration on many farms in many sections of Mississippi.

In any case, it is important that the farmer consider his total farm income in figuring out his land use program which includes the selection of pasture land. In order to figure the greatest total farm income, it is probably necessary, therefore, that he estimate the cost of production and returns in the light of labor, machinery, and investment available for the various crops or enterprises in his type of farm business so that he might apportion the land to these enterprises in such a way as to obtain the greatest total returns for the farm.

A suggestive form is shown in table 15 for estimating the cost of establishing and maintaining pasture and returns from same. A summary of various pasture practices in four soil areas in Mississippi are shown on pages 11 to 22. These summaries show the practices done and the extent of the practices and in the light of present prices these figures might be some basis for figuring the cost of these pasture improvement practices. However, it is not intended here to say that the practices used by the farmers in this study are the best practices. It does show what has been done by 86 farmers surveyed from which survey the approximate cost can be calculated and also the approximate value of the practices in the form of production or carrying capacities of the pastures. Also, various fertilizer tests are shown on pages 43 to 70 which might be used as a basis for calculating the cost of this practice and returns therefrom. In addition, experimental results on pages 33 and 93 to 96 might give some basis for determining cost of con-

Table 15. Estimate of cost of establishing and maintaining pasture and returns per acre

PRACTICE	Cost of labor	Cost of material	Other costs	Total cost	Value special aids (A.A.A., etc.)	Total costs (less value of special aids)
Costs:						
Clearing or brushing						
Preparation of land						
Seeding						
Controlling weeds, etc						
Fertilizing						
Terracing or contouring						
Other						
Total costs						
Returns:						$
Increased beef gains or milk production (pounds)						
Value of increased production (dollars)						
Gain or loss from practices (dollars)						

trolling weeds or undersirable plants and the value of same. On pages 26 to 33 experimental tests show the value of improved pastures compared to unimproved pastures, which in most cases, include most all of the so-called improved practices. Also, in the same section is shown a summary of the study.

From the information cited above, it seems that a farmer might be able to estimate, fairly accurately, the approximate cost of establishing and maintaining pastures as well as returns therefrom on the form shown in table 15. The farmer is already fairly well versed in estimating costs and returns from the row crops which he has been growing. Therefore, if he is able to calculate the probable returns from pasture on his farm this should help him to decide what land should be devoted to pasture from an economical standpoint and from the standpoint of how it will effect his total farm income.

PART IV

PREPARATION OF LAND FOR PASTURES*

In establishing pastures, the matter of preparation of land is the first consideration. This includes clearing the land (in case of new land that has not been in cultivation) of bushes, briars and other undesirable growth, terracing or drainage, breaking and leveling.

Experience and observation have definitely shown that it is necessary to clear the land of timber, bushes and undesirable plants before satisfactory pastures can be established. When this is done and undesirable plants are kept under control, comparatively good pastures have been established with no other treatments where the soil was of average fertility.

Observation has also shown that where hill pasture land has been properly terraced, there is more grazing immediately above the terraces during medium to dry seasons than elsewhere in that additional moisture has been stored in the soil by the terraces.

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*Taken from Mississippi Agricultural Experiment Station Circular 108, "Preparing Brush Land for Pastures," September 1942.

More detailed information on this subject is shown below from Mississippi Agricultural Experiment Station references. This information includes some results of tests at the main station as well as discussion and recommendations.

Clearing Brush Land

The Animal Husbandry Department of the Mississippi Experiment Station, during the past 10 years, has converted into productive permanent pasture approximately 800 acres of land that was once cultivated but had been abandoned from 2 to 20 years. This land had grown up in sprouts, briars, broom sedge and weeds, which had to be removed. Hand labor and axes have been used practically altogether in the clearing operation. Brush were cut even with or below the ground level in order to simplify mowing and to reduce hand labor involved in resprouting during later years.

It was found that with the average laborer, very close supervision is required in order to get the sprouting work done satisfactorily. The tendency is to leave several inches of stump above the ground. This kind of clearing makes for a poor mowing job, broken machinery, and added expense of resprouting for several years. There is very little difference in the cost of cutting sprouts up to 3 to 4 inches in diameter even with the ground surface, and that of cutting them several inches or a foot high. The brush was piled and left until dry enough to burn.

On land where broom sedge is reasonably thick, if the clearing is done after frost or during the winter, one firing will clean the land with the use of a follow-up crew to assemble the butts of sprouts left unburned. If broom sedge is thin, it may be necessary to use a mowing machine to clean the land completely after the brush has been burned.

As was stated above, the cost of getting brush land ready for the mowing machine will vary according to the amount of brush covering; however, other factors may be involved.

During February and March 1941, the Department set up a grazing experiment involving the use of 240 acres of land located in the Flatwoods Area about 20 miles southwest of Starkville. This land had previously been in cultivation but had been abandoned for 5 or more years. The sprout covering consisted largely of loblolly pine but also included oak, gum, and black jack, and varied from quite thin to quite thick. Broom sedge covered the entire area except the lower, more fertile parts which were covered with a thick growth of briars in addition to sprouts. The entire area was burned about two weeks after the brush was piled, and fortunately the broom sedge was thick enough to make the burning complete.

Cost of clearing, effect of mowing. The total labor cost of clearing this tract of land, consisting of 240 acres, was $571.36 or $2.38 per acre; however, such costs will most likely vary according to the covering and local wages as well as machinery available. Since it was cleared, all of the acreage has been handled with a mowing machine and without the use of hand labor and axes for resprouting. In general, it might be observed that where sprouts reappear it might be necessary to use the mowing machine two or three times during the growing periods, and it is always advisable to mow at the end of the growing season. If sprouts are left they become tough and hard during the winter and it will be difficult to do a good mowing job the following year.

During 1941, the year in which land was gotten ready for mowing as above described, 3 bulls and 60 mature cows and their calves were grazed on the 240 acres, and enough hay was cut and stacked at the second mowing to winter these animals without additional feed until March 1. It appeared at mid-September that no hay would be secured at the second clipping that year (1942) due to dry weather, although grazing had been sufficient. This tract is included in a minerals experiment, and no seeding or sodding was done, dependence being placed entirely on pasture plants (mostly broom sedge) already established or which might become established without seeding during the experiment. This lack of seeding was done for the purpose of the experiment and is not recommended as a good pasture practice; but the practices of brush-clearing and mowing have clearly demonstrated their worth and practicability.

Clearing costs. It should be emphasized, first, that this land had once been in cultivation and contained only a limited number of large trees. The growth of brush was extremely thick in some places and thin in others. Second, labor was paid at the 1941 rate of 10 cents per hour. For these reasons, it is impossible to arrive at even an approximation of average cost throughout the State, though it is believed that much land abandoned from cultivation during recent years can be prepared for pasture at a cost that would not be prohibitive.

Mowing to control sprouts. Once the potential pasture land is prepared for seeding by cutting of trees, shrubs and other undesirable plants, at or below the ground level, it is proven by the experience of the Animal Husbandry Department over a period of 10 years that mowing will effectively control sprout growth. By mowing twice a year, the sprouts are tender and will be clipped without difficulty by the mowing machine. By clipping twice a year the root systems of the undesirable plants are gradually starved out or exhausted so as to be eliminated. At the same time, even the numerous sprouts which may occur during the first year will not seriously interfere with the growth of pasture plants, provided the undesirable plants are clipped twice by a mower; and the clipping to control sprout growth is also highly desirable to control weed growth and permit seeded or sodded pasture plants to make good growth and become well established.

Seedbed Preparation, Terracing and Drainage

The amount of soil preparation necessary in pasture making will vary according to the condition of the land, the preceding crop, desirable plants already growing, and the amount of undesirable plants present.

Should land that is to be put to pasture have slope enough to be subject to erosion, means should be provided for erosion control. Such structures as terraces and diversions should be constructed that will satisfactorily break up an excessive accumulation of water and divert this water to natural drainage areas or into well-vegetated areas. The construction of mechanical structures is more important on land to be seeded, as it prevents the movement of seed by flowing water and the starting of gullies before the soil is covered with pasture plants. When converting previously terraced fields to pasture, the terraces and the row system should be reworked so that all rows are on a contour and the furrows are shallow enough to allow mowing.

Proper drainage is often as important as erosion control measures. Especially is this true of the Delta and Prairie sections and of fertile bottoms in other sections of the State. Many Prairie pastures contain seepage areas which may be drained by means of terraces, in which case the terraces serve a two-fold purpose.

Much land to be converted into pastures may have varying amounts of desirable plants growing. Thus, common lespedeza may be found throughout the Brown Loam Area, or hop clover throughout the Prairie. Plowing such land might injure or eradicate stands of these plants, and money and time could be more profitably spent in eradicating undesirable plants so as to promote the growth of the desirable plants already established and incorporating other species desired, than in soil preparation. Plowing should be done where there is such a dense growth of undesirable weeds or other plants that pasture plant seed might not come into contact with the soil. Soil that is caked or too hard for root penetration should be loosened by plowing or disking.

In cases where soil preparation is made, it should be done far enough in advance of planting for the seedbed to become firm. All experimental evidence points to the necessity for seeding on a firm seedbed. In any case, whether with much or little soil preparation, prerequisites for pasture development include elimination of obstructions so that farm machinery may be used, and the planting of pasture plant species on a firm seedbed.*

From contacts made as well as observations and investigations made in this pasture study it seems that the general consensus among farmers and agricultural workers in the field is that thorough breaking of soil is not always desirable in pastures already established. However, if new land that is put into pastures is rough and rugged it should be broken enough so that it can be leveled in order that the pasture may be mowed. Of course there are advantages and disadvantages in breaking new pasture land. Some of the advantages have already been mentioned above; namely, (1) breaking is a means of leveling the land so that it can be mowed efficiently (2) Breaking may destroy certain noxious weeds or plants. (3) In addition, if the land is extremely hard, breaking provides a better seedbed if allowed to settle before seed are planted. On the other hand there seems to be some disadvantages in breaking land. (a) On hill land, erosion is increased until the land becomes sodded with grasses. (b) Breaking destroys cover on the land; such cover, if allowed to remain on the land, would provide some protection for young pasture plants, from the hot sun, cold, and grazing, especially where the new pasture is heavily grazed.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 5 and 6, State College, Mississippi, July 1941.

PART V

FERTILIZING PASTURES

As already pointed out in this bulletin, many farmers and agricultural leaders contacted in this study, stated that fertilizing pastures gave better results than any other practice used. This may be due to the fact that little pasture fertilization has been done until recently even on pastures that were grazed continuously, thus taking plant food out of the soil while but little was put back into the soil. Too, a large percentage of the land found in pasture, especially hill and terrace land, had previously been growing row crops, and no doubt much of such land was pretty well depleted of its fertility. On most of the farms surveyed, improvement practices such as seeding and fertilization, were made on old established pastures.

Table 6, which is a summary of the 86 farms surveyed in all areas, shows that about 64 percent of the pasture land surveyed had been limed during the past 5 years, with an average of 863 pounds of lime per acre. About the same percentage had been phosphated with an average of 227 pounds per acre. About 30 percent of the land had basic slag applied at the rate of 538 pounds per acre, while only about 3 percent of the land had an application of potash at the rate of 151 pounds per acre. All farmers contacted indicated that pastures that had not had an application of fertilizer recently, would receive one in the near future. Some farmers were following the practice of fertilizing one-third or one-half of their pasture each year until the entire pasture was fertilized.

Experimental results on fertilizing pastures are shown on the following pages for various crops, soil types, and areas in Mississippi, and in surrounding or nearby states.

Fertilizing Pastures

Conducted by: Holly Springs Branch Experiment Station.

Conducted at: Holly Springs, Mississippi.

Period: 1937-40.

Purpose: To determine the effect of different fertilizer treatments on the yield of dry matter in pasture.

Procedure and conditions: An established permanent pasture at Holly Springs that would be considered an average of the pastures in the hill sections of this area was used for this test. A series of fertilizer treatments was

Table 16. Influence of fertilization on the yield and grazing of top-dressed pastures on Grenada soil; Mississippi, 1937-1940.

Treatment	Pounds dry matter per acre, av. 1937-40	Percent of growth not grazed
L - Lime 4000 lbs. (applied 1937)	2904.0	32.16
P - 400 lbs. superphosphate (20%)	6193.6	6.44
N - 250 lbs. nitrate of soda (16%)	3891.3	40.12
K - 80 lbs. muriate of potash (50%)	3742.8	22.43
LP*	5237.0	5.64
LK*	4006.0	18.27
LN*	4858.7	30.09
LPK*	4561.5	15.80
LPKN*	5542.6	25.13
None	3236.3	23.91

*Combination of lime, phosphorus, nitrogen, and potash in quantities listed in first four lines of table.

Table 17. The effect of a single application and of four annual applications of superphosphate; Mississippi, 1937-1940.

Treatment	Pounds of dry matter per acre			
	1937	1938	1939	1940
Check	1763.3	3912.3	3578.2	3691.2
400 lbs. super in 1937	3097.3	6324.9	4399.8	4495.2
400 lbs super annually	3097.3	8787.2	5769.3	7120.5
	Percent increases over check			
400 lbs. super in 1937	75.7	61.6	23.0	21.8
400 lbs. super annually	75.7	124.6	61.2	92.9

applied broadcast in February on random plots throughout the pasture. One application of lime was made during the period, all other treatments being annual applications. Check plots were left untreated for comparison.

Areas of both fertilized and check plots were protected from grazing by means of movable cages. Total yields were obtained by harvesting the growth at frequent intervals so as to simulate grazing conditions. Unprotected areas of the same size and number, treated and untreated, and representative of the growth left by grazing cattle, were clipped at the same time. All yields are reported as dry matter per acre. The difference between the yields

Table 18. Effect of different fertilizer analyses on pasture yields; Mississippi, 1937-40.

Analyses*	Pounds of dry matter per acre	
400 lbs. per acre	Limed	Not limed
0-0-4	4493.2	3470.2
0-4-0	4680.1	4611.7
8-0-0	3845.0	3733.3
0-8-4	6016.2	5870.9
4-8-4	5259.7	5818.4
0-8-8	5858.0	5750.3
6-8-4	5656.7	5458.7
8-4-4	5264.9	4329.0
8-12-4	6656.1	5688.6
8-0-4	3862.8	3410.9
8-8-0	5938.4	5770.9
0-12-0	6841.4	6367.6
0-8-0	6279.1	5613.0
0-0-8	3636.2	3803.4
8-8-8	6574.2	5868.1
0-0-0	4287.2	3857.4

*Nitrogen, phosphoric acid, and potash in the order named.

of the protected areas and yields of the unprotected areas represents the quantity of pasture growth that was eaten by the grazing dairy animals. These differences are reported as the percentage of growth not eaten. Four-year averages of yields and rate of grazing are reported in table 16.

These 4-year averages show several outstanding and significant results. Surprising may be the effect of liming, in that where 4,000 pounds of dolomitic limestone was applied in 1937 the yield was less than on the untreated plots four seasons later or in 1940. However, there was only 276.3 pounds of dry matter per acre difference in favor of the unlimed plots in 1940. How long this overliming effect will remain will be ascertained by further measurements. These results indicate the advisability of smaller amounts of limestone, applied more frequently, when broadcast on pastures growing on this type (Grenada silt loam) of soil.

The results obtained by the application of phosphate are outstanding. The use of 400 pounds of 20 percent superphosphate, gave a 4-year average increase over the untreated plots of 91.38 percent. The use of the heavy amount of lime in combination with phosphate reduced the yield to less than the yield from phosphate alone. Heavier applications of phosphate in combination with 400 pounds of lime failed to overcome the overliming effects. The likelihood is that the large amount of lime not only ties up the phosphate in unavailable form, but also ties up other elements, and that in such combination they are unavailable and are thus the limiting factors for plant growth.

Further observations of the data show that the application of other elements alone or in combination with lime failed to give increases like those obtained with phosphate alone. Yearly applications of phosphate gave yearly increases in plant production. One 400-pound application made in 1937, however, with no additional application thereafter, was giving an increase over the no-phosphate plots 4 years later. This comparison is shown in table 17.

The manner in which cattle grazed these plots is very significant. It will be noticed that where phosphate was used there was not only more plant material produced, but also the plant material produced was grazed in preference to other treatments. This was true whether the phosphate was applied alone or in combination with other elements, though it was observed that the cattle left more of the herbage on plots treated with various elements than they did on plots with the same treatments plus phosphate.

Data in table 18 shows that phosphorus again was the most efficient and the most profitable element used whether the phosphorus was applied alone or in combination with other elements. Nitrogen used alone and nitrogen used with potash produced less than the unfertilized check, whether the plot was limed or unlimed. This was due to the early stimulation of grass at the expense of legume growth. Potash used alone resulted in a slightly higher yield on the limed plots and a slightly lower yield on the unlimed plots.

The data shows that phosphorus with small amounts of lime make the best pasture fertilization practice on these soils.

It should be pointed out that overliming is more easily done on the sandy types of soil than on those containing more silt or clay. For example, the amount of lime needed to neutralize (bring to a pH reading of 7.0) a Grenada silt loam with an acidity of pH 5.5, would when added to a Ruston fine sandy loam of the same degree of acidity cause the Ruston to become more than neutral, pH 8.2. The sandy soils also contain less minerals for plant growth, and nutrients in sandy soils are thus tied up in an unavailable form with less lime than is the case with silt or clay soils.

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," pages 28-31, tables 15, 16 and 18, State College, Mississippi, July 1941.

Liming Pastures

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Pearl River County, Mississippi.

Period: One year, 1940.

Purpose: To determine the effect of lime, with superphosphate, on the yield of dry matter.

Soil: Norfolk very fine sand.

Procedure and conditions: The response of Norfolk soil to small quantities of lime is shown by the yield of pasture clippings from a pasture growing on Norfolk very fine sand. A carpet grass-lespedeza hill pasture on this soil type in Pearl River County was top-dressed in January 1940, with varying amounts of dolomitic limestone in combination 200 pounds of 20 percent superphosphate. The dry matter produced per acre is shown in table 19.

Table 19. Effect of top-dressing with varying amounts of lime on Norfolk very fine sand; Mississippi, 1940.

Pounds applied per acre			Yield
Dolomite	plus	Superphosphate	Pounds dry weight per acre
80	plus	200	2095.7
160	plus	200	2273.4
240	plus	200	2517.8
320	plus	200	2695.5
480	plus	200	4124.7
960	plus	200	3554.5
No treatment			1399.6

These data show that top-dressing with 1,000 pounds of lime reduces pasture yields on Norfolk soil, while a 500-pound application of lime was highly beneficial. By comparing with the data in table 18 it will be noted that the amount of lime which reduced the yield on sandy soil produced an increase in yield on a silt loam soil. It should be emphasized that these reductions occurred with top-dressing without further treatment. Where land is being prepared for seeding or when lime is worked into the soil, it is possible that greater quantities of lime would be required to produce the overliming effects.

Use of Basic Slag and Potash on Brown Loam Soils

The effect of basic slag is much the same as that of phosphate and lime on the sandy, as well as the silt or clay soil types, when pound for pound of available phosphoric acid are applied. The 2-year average dry matter yield obtained from top-dressing with comparable amount of basic slag and superphosphate and lime on Grenada silt loam are:

Treatment	Dry matter, pounds per acre
1000 pounds basic slag	4473.8
400 pounds 20% super plus 1000 pounds lime	4618.9

These data indicate that the cost of material and its application would determine which (basic slag or super plus lime) to apply to pastures. However, on soils of a low fertility and where the cost of materials is approximately the same, basic slag is preferred because it contains elements in addition to calcium and phosphorous.

On many soils—those that have been heavily cropped to lespedeza or other legumes, those where grazing has been practiced over a long period and legume growth is scant, or those of a low fertility—the application of potash materially increases the yield of pasture growth. Top-dressing an established and heavily grazed pasture on Olivier (a second-bottom terrace soil of the Brown Loam Region) gave the following 2-year average results:

Treatment	Dry matter. pounds per acre
None	4442.3
100 pounds muriate of potash	5347.8
200 pounds 20% superphosphate	5146.1
100 pounds muriate plus 200 pounds superphosphate	6597.5

These data show that soils that are low in potash or that have been grazed over a long period of time, give profitable response to potash applications.

It may be pointed out that all pasture soils of the State may not be as responsive to phosphatic fertilization as is the Grenada type. However, the general effect of phosphates is the same: an increase in the legume population and its growth. On many soils it is necessary to apply lime, phosphorous, and potash to obtain a profitable stand of clover.

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," pages 31 and 36, table 19, State College, Mississippi, July 1941.

Comparative Improvement in Pasture through Fertilizing and Liming with Results in Terms of Cattle Gains

Conducted by: Arkansas Agricultural Experiment Station, Fayetteville.

Conducted at: Cotton Branch Station, Marianna.

Period: 1927-33.

Purpose: To compare gains made by cattle on fertilized and on unfertilized pasture.

Land history: The land had been in cotton and an occasional crop of corn for 65 years, without cover crops or fertilizers. It had been abandoned as unprofitable for farming.

Soil: The soil was a silty and clayey loam, classified as Lintonia silt loam. The land was submarginal; half the area was severely eroded and one-third was poorly drained. The average degree of slope was 4½ percent.

Procedure and conditions: In 1927 the establishment of a permanent pasture on the area was begun. Prior to this time seedings of common grasses and legumes had failed to give favorable results. The land was plowed in early spring and prepared for planting. Furrows 5 to 6 inches deep and 2 to 3 feet apart were opened. In these, pieces of Bermuda sod were dropped about 2 feet apart, and covered. The surface was then smoothed and seed of carpet grass, Dallis grass and other grasses, and white clover and hop clover (light seeding) were sown on the surface as early in spring as practicable. Lespedeza seed was sown at the rate of 8 pounds per acre in late March or early April and bur clover seed was sown at the rate of 1 bushel per acre in July or August for early fall germination. When necessary, white clover and hop clover seed were sown at the rate of 5 pounds each per acre, usually in September. If a satisfactory stand of lespedeza did not result from the first seeding, a second seeding was made a year later. These seedings were made on the surface and the soil was not cultivated after the Bermuda grass had been set.

Weeds and tall growth were cut with a mowing machine when necessary, usually about May 15 and occasionally in August or September. Grazing stock were excluded from the area as much as possible. Occasional touching up of thin spots was necessary during the next 2 years.

In 1930 grazing studies were begun on the pasture land. Two areas of 3.3 acres each were fenced, and provided with shade, salt, and water. One area was fertilized with nitrate of soda, the other was left unfertilized. The experiment was conducted on the same land continuously.

Grade Shorthorn and Hereford steers ranging in age from 12 to 18 months, lean but of fair quality and weighing approximately 250 pounds, were used on the pastures. They had been kept and fed as usual, chiefly on roughages, prior to being used in the experiment. The cattle were divided as evenly as possible between the two areas, on the basis of types and weights. They were kept on pastures continuously and weighed individually on the 1st and 16th of each month during the grazing season.

During the grazing season the number of animals on the pasture was varied as necessary. In dry periods the numbers were reduced, and when rains improved the pasture growth, animals were restored in proportion to the improvement made so as to maintain a desirable balance between the pasturage available and the number of animals. During the early part of the season when the growth of legumes was greatest, the fertilized pasture was stocked at the rate of nearly four head per acre. An average of 417 grazing days per year was secured on the fertilized pasture and 316 days on the unfertilized pasture. The

Table 20. Gains made by cattle on fertilized and on unfertilized pasture; Marianna, Arkansas, 1930-31[1]

Date of taking weights	4-year average gain of all cattle on		Date of taking weights	4-year average gain of all cattle on	
	Fertilized pasture	Unfertilized pasture		Fertilized pasture	Unfertilized pasture
	Pounds	Pounds		Pounds	Pounds
May 1[2]	[3]218	166	Aug. 16	91	55
May 16	346	272	Sept. 1	5	27
June 1	186	172	Sept. 16	-44	-87
June 16	255	198	Oct. 1	1	36
July 1	51	16			
July 16	-52	-45	Av. gain per acre	334	248
Aug. 1	47	10			

[1] In 1930 nitrate of soda was broadcast on the surface in the spring, and again in June, at the rate of 75 pounds per acre.

[2] Cattle placed on pasture in early April.

[3] 3-year average, 1930, 1931, and 1933. Grazing not begun until May 5 in 1932.

cattle received no other feed. When the stock was taken off or returned to pastures, the usual weighings were taken before the change was made.

The same cattle were used in 1931, but were re-grouped. High grade, yearling Hereford steers were used in 1932 and 1933 (not the same animals both years, however).

The grazing period each year extended approximately from early April to November 1.

A severe drought occurred late in the 1930 season. The 1931 season was more favorable, and the 1932 and 1933 seasons were about average.

Reference: United States Department of Agriculture, Agricultural Adjustment Administration Bulletin SRAC-5, "Permanent Pastures," pages 28 and 29, table 20, Washington, D. C., June 1938.

Fertilizing Pastures in Black Belt of Alabama

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Marion Junction, Alabama.

Period: 1933-42.

Purpose: (1) To compare large amounts of phosphate applied at 3-year intervals with smaller applications made annually. (2) To determine the increase in pounds of beef by the use of nitrogen, phosphorus, and potash. (3) to find the best adapted group of plans for pastures.

Soil: From 1932 to 1935, four-acre plots were used, 1 acre being upland and 3 acres bottomland. From 1936 to 1942 the plots contained only 3 acres of bottomland.

Procedure and conditions: In the fall of 1931, all plots received a mixture of seed sufficient for a stand of the following: White clover, black medic, and biennial white and annual yellow sweet clovers. Seed sufficient to produce a stand of Dallis grass, red top and orchard grass were sown on all plots the following spring. In 1935 Kentucky blue grass was sown at the rate of 5 pounds per acre. No additional seeding of any kind has been done. However, heavy grazing, weather extremes, and competition with other plants have taken a toll. Several of these species have been eliminated in the 12 years. The predominate species now are black medic, white clover, Dallis grass and bluegrass. However, bluegrass is not as desirable for pasture as is a rotation of the adapted clovers and Dallis grass. Because of its tendency to crowd out the other grasses and especially the clovers, bluegrass subsequently suffers from the lack of nitrogen. The natural rotation of clovers and grasses worked almost ideally. The clovers predominate in the early season, and then give way to Dallis grass in the latter part of the season. The clovers leave sufficient nitrogen in the soil to stimulate greatly the later crop. Results on fertilizer treatments are shown in table 21 and 22.

Table 21. Average production of beef per acre from the use of fertilizers on Black Belt pasture, 10-year period; Alabama, 1933-42.

	Frequency of application	Average annual yield of beef pounds	Increase from fertilizer pounds
Superphosphate, 1200	3 years	352	166
Superphosphate, 600	3 years	276	90
None	--------	188	-----
Superphosphate, 200	Annual	241	55
Superphosphate, 400	Annual	307	121
Superphosphate, 800	Annual	306	125
Superphosphate, 800; nitrate of soda, 250	Annual	354	174

Table 22. Beef production per acre from potash as an addition to phosphate and nitrogen on Black Belt pastures, Alabama 10-year period, 1933-42.

	Feed treatment in pounds per acre			
	Superphosphate, 800 ; nitrate of soda, 250	Superphosphate 800 ; nitrate of soda, 250 ; muriate of potash, 100	Superphosphate, 800 ; nitrate of soda, 250	Superphosphate, 800 ; nitrate of soda, 250 ; muriate of potash, 100
Frequency of application	Annually	Annually	Annually	Annually
Av. annual yield of beef	298	313	391	471
Increase due to potash	......	15	......	80

Reference: Reprinted from Journal of the American Society of Agronomy, Vol. 36, No. 9, September 1944, "A Year-Around Grazing Program for the Alkaline Soils of the Black Belt of Alabama," pages 741, 742, and 744, tables 1 and 2.

Fertilizing Permanent Pastures in the Black Belt of Alabama

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Marion Junction, Alabama.

Period: 1937-1944.

Purpose: To determine the effect of phosphate on beef gains when applied on pasture.

Soil: Sumpter.

Procedure and conditions: Six hundred pounds of superphosphate was applied to each acre annually during the entire period. Sixteen percent superphosphate being used during the period 1937-1942 and 18 percent being used during the period from 1942-1944.

Grazing results are shown in table 23.

Table 23. Effect of phosphate on pastures in terms of pounds of beef gains, on Prairie Soil, Marion Junction, Alabama

	Plot 1 Unfertilized	Plot 2 Fertilized
Pounds superphosphate applied per acre	0	600
Average pounds of beef gained annually per acre	90	316.75

Reference: Unpublished data from the Agricultural Experiment Station, Marion Junction, Alabama.

Fertilizing Upland Pastures

Conducted by: Alabama Agircultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1925-32.

Purpose: To determine the effect of various fertilizer treatments on the yield of upland pasture composed of several grasses and legumes.

Land history: Planted to clean-cultivated crops for at least 30 years prior to 1925. The cropping history is not available because the land was not under control of the Experiment Station until 1925.

Soil: The soil was typical upland Norfolk sandy loam of very low natural fertility. The land had a 3 percent slope, and there was little erosion.

Procedure and conditions: Twenty-one plots in duplicate were used, each plot being 9 by 12 feet, or 1/403 of an acre in area. Duplicate sections were separated by 2-foot alleys and unlike sections were separated by 4-foot alleys. Half of the plots were limed at the beginning of the experiment. The experiment was run continuously on the same land.

In the fall of 1925, the plots were seeded with bur clover at the rate of 27 pounds per acre, and a mixture composed of one part each of common and Ladino white clovers and two parts of black medic, at the rate of 9 pounds per acre. Inoculated soil was scattered over the area. In March 1926, Dallis grass and common lespedeza were sown on these plots at the rate of 20 pounds per acre, and Korean lespedeza was sown at the rate of 10 pounds per acre. They were covered lightly with a weeder.

In September 1926, another seeding was made with the addition of Carolina clover and hop clover to insure a thick stand of plants. In the spring of 1927 the Dallis grass seeding was repeated at the rate of 12 pounds per acre.

In order to determine whether or not centipede grass could become established in competition with other pasture plants which were already established, six plants of centipede grass were set on each plot in the experiment in July 1928.

Phosphate and potash fertilizers were applied at 5-year intervals (except on one plot where they were applied annually). Two such applications were made, one in the fall of 1925 when the phosphate and potash fertilizers were worked well into the soil when the seedbed was prepared, and the other in January 1931 when these materials were applied as a top-dressing. Nitrogenous fertilizers were applied annually as top-dressings.

The plants were seeded at rates which were higher than would be practical in pastures, because it was desired to establish a sod for the experiment as quickly as possible.

Table 24. Green and dry weight yields of herbage from upland pasture plots variously fertilized, Auburn, Alabama, 1927-32.

Fertilizer treatment[2]	6-year average yield of green and dry material per acre,[1] 1927-32			
	Unlimed		Limed[3]	
	Green	Dry	Green	Dry
	Pounds	Pounds	Pounds	Pounds
None (Check)[4]	2,905	902	3,642	1,121
N	5,017	1,466	5,037	1,455
NP	6,584	1,884	7,866	2,187
NPK	6,976	1,967	8,751	2,393
NPK (N as ammonium sulphate)	5,476	1,579	8,237	2,299
NPK (P as basic slag)	7,053	2,007	7,835	2,193
2N, 1/3P, 1/3K	6,445	1,862	7,830	2,193
P	3,795	1,091	5,000	1,413
PK	4,323	1,254	6,031	1,657
N, 1/6P, 1/6K (top-dressed annually)	6,694	1,912	8,395	2,343
NPK (N in two equal applicatons)	6,289	1,792	8,663	2,360
2N, PK (N in two equal applications)	8,645	2,416	11,206	3,093
3N, PK (N in three equal applitions)	10,366	2,930	13,035	3,597
1/2N, 2P, 2K	5,694	1,633	9,548	2,569
1/2N, PK	5,881	1,685	8,136	2,248
2N, 2P, 2K	9,553	2,703	12,240	3,329

[1] Each figure is the average of two duplicate plots. The grasses and legumes on the plots were mainly clovers, Dallis grass, and centipede grass.

[2] The treatment (Labeled NPK in the table) consisting of the following proportions of NPK was considered the standard: N represents 200 pounds of nitrate of soda per acre annually, P represents 600 pounds of superphosphate every 5 years, and K represents 150 pounds of muriate of potash per acre every 5 years. Treatments on all the other plots were variations of this standard.

[3] Limed at the rate of 2 tons of ground limestone per acre in the fall of 1925.

[4] Average of 6 check plots. Calculated by the Southern Division, A.A.A.

Reference: United States Department of Agriculture, Agricultural Adjustment Administration Bulletin SRAC-5, "Permanent Pastures," pages 41 and 42, table 26, Washington, D. C., June 1938.

Comparison of Fertilizer Treatments on Yields of Dallis, Carpet, and Bermuda Grass

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1925-1932.

Purpose: To determine the effects of various fertilizer treatments on yields of Dallis, carpet, and Bermuda grass, planted alone and as a mixture.

Land history: The land had been planted to clean-cultivated crops for at least 30 years prior to 1925. The cropping history is not available because the land was not under control of the experiment station until 1925.

Soil: The soil was typical upland Norfolk sandy loam of very low natural fertility. The land had a 3 percent slope, and was slightly eroded.

Procedure and conditions: Four sections, each with two replications of five plots, were used. Each plot was 9 by 12 feet, or 1/403 of an acre in area. Sections were separated by 4-foot alleys. The experiment was run continuously on the same land.

The seedbed was well prepared, and in the fall of 1925 the entire area was sown to Southern bur clover at the rate of 27 pounds per acre, and to a mixture of one part of common while clover, one part of Ladino clover, and two parts of black medic, at the rate of 9 pounds per acre. Inoculated soil was sown with the seed.

In the spring of 1926 this area was divided into four sections. One section was seeded to Dallis grass at the rate of 18 pounds per acre; one to carpet grass at the rate of 9 pounds per acre; one to Bermuda grass at the rate of 9 pounds per acre; and one to all three of the grasses at their respective rates. Common lespedeza at the rate of 15 pounds per acre, and Korean lespedeza at the rate of 10 pounds per acre, were seeded on the entire area along with the different grasses. Very few of the Bermuda grass seeds germinated and, therefore, sod was set in May 1926. In the fall of 1926 the seeding of the previous fall was repeated on all sections. In the spring of 1927, Dallis and carpet grass were again seeded on their respective sections at the rate of 12 pounds per acre. Although hop clover was not seeded in this experiment, some of it scattered from a similar experiment nearby, and by 1929 there was a scattered stand on the Dallis and carpet grass sections. By the spring of 1930 there was a good stand of hop clover on these two sections and some on the Bermuda grass section. After 1931 there was a thick stand of hop clover on these sections.

Phosphate and potash materials were applied and worked into the soil when the seedbed was prepared in 1925. In January 1931, a second application was made as a top-dressing. Nitrogen was applied annually as a top-dressing. On some of the plots ground limestone was applied along with the phosphate and potash in the fall of 1925. No lime was applied after that date.

In order to simulate heavy grazing, the grass was harvested with the cutter bar of the lawn mower set as low as practicable. The lawn mower had a basket attachment. The plots were harvested as often as there was sufficient growth. This was considered a more accurate method of determining the results than actual grazing.

Bur, common, and Ladino white clovers, and black medic were winter-killed in January 1928 and practically none of these plants grew after that date. Lespedeza failed to mature enough seed to propagate itself during the two dry seasons of 1930 and 1931, so there were only a few of these plants on any plots in 1932.

Table 25. Green and dry weight yields of Dallis, carpet and Bermuda grass alone and as a mixture, variously fertilized; Auburn, Alabama, 1927-32[1]

Fertilizer Treatment[3]	6-year average yield per acre, 1927-32[2]							
	Dallis grass		Carpet grass		Bermuda grass		Dallis, Carpet and Bermuda grass mixture	
	Green	Dry	Green	Dry	Green	Dry	Green	Dry
	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds	Pounds
None (check)	2,568	769	2,216	644	1,313	415	1,662	494
NPK	5,854	1,649	5,263	1,439	3,834	1,173	3,926	1,095
NPKL	7,697	2,115	6,754	1,784	5,765	1,651	5,174	1,452
1/2N, 2P, 2KL	8,142	2,208	7,348	1,917	6,254	1,735	4,680	1,276
2N, 1/3P, 1/3K	7,479	2,155	5,610	1,607	4,507	1,399	5,488	1,587

[1] Common and Korean lespedeza were sown on all sections.

[2] Each figure is the average yield of two duplicate plots.

[3] N represents 200 pounds of nitrate of soda per acre annually, P represents 600 pounds of superphosphate per acre every 5 years, K represents 150 pounds of muriate of potash per acre every 5 years, and L represents 2 tons of ground limestone per acre applied at the beginning of the experiment in the fall of 1925.

Reference: United States Department of Agriculture, Agricultural Adjustment Administration Bulletin SRAC-5, "Permanent Pastures," pages 44 and 45, table 28, Washington, D. C., June 1938.

Comparison of Yield of Bermuda Grass, Carpet Grass and Centipede Grass with Various Fertilizer Treatments

Conducted by: Georgia Coastal Plain Experiment Station in cooperation with the Division of Forage Crops and Diseases, Bureau of Plant Industry, and the Animal Husbandry Division, Bureau of Animal Industry, of the United States Department of Agriculture.

Conducted at: Tifton, Georgia.

Table 26. Yields of Bermuda grass, carpet grass, and centipede grass on upland soil fertilized with various combinations of NPK applied at the rate of 600 pounds per acre, Tifton, Georgia, 1931-34.

Fertilizer formula[2] (applied at the rate of 600 pounds per acre)	Dry-weight yield of grasses per acre[1] Bermuda grass, 2-year average 1931-32	 Carpet grass 3-year average 1931-33	 Centipede grass 4-year average 1931-34
Phosphoric acid series:			
	Pounds	Pounds	Pounds
6-12-6 (check)[3]	1,472	2,018	1,846
6-0-6	1,436	1,881	1,774
6-8-6	1,453	2,064	1,802
6-16-6	1,703	1,810	1,885
Ammonia series:			
6-12-6 (check)[3]	1,472	2,018	1,846
0-12-6	787	1,369	951
4-12-6	1,150	1,661	1,412
8-12-6	1,552	2,141	2,286
Potash series:			
6-12-6 (check)[3]	1,472	2,018	1,846
6-12-0	1,518	1,540	1,750
6-12-4	1,609	2,026	1,659
6-12-8	1,536	2,228	1,815
Lime and split applications:			
6-12-6 (check)[3]	1,472	2,018	1,846
6-12-6, lime[4]	1,301	2,001	1,614
6-12-6 (split)[5]	1,596	2,531	1,867
6-12-6[6]	1,335	2,164	1,647
Incomplete formulas:			
0-12-0	755	1,671	730
6-0-0	1,332	1,614	1,639
0-0-6	756	1,796	584
0-0-0	780	1,493	555

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[1] Air-dried.

[2] Ammonia, phosphoric acid, and potash in the order named.

[3] Complete fertilizer.

[4] 2,000 pounds ground limestone every 3 years, 1931 and 1934.

[5] One-half of the nitrogen was applied in the early spring, the other half in midsummer.

[6] Nitrogen applied annually, superphosphate and potash every third year.

Period: 1931-34.

Purpose: To compare yields of Bermuda grass, carpet grass, and centipede grass on upland soil fertilized with various combinations of a 6-12-6 (NPK) mixture applied (in whole and split applications) at the rate of 600 pounds per acre.

Land history: In cultivated field crops previous to 1931.

Soil: The centipede and Bermuda grass pastures were on fairly moist Tifton sandy loam and the soil of the carpet grass pasture bordered on Norfolk sandy loam. The land sloped gently and there was no erosion.

Procedure and conditions: Plots were 1/200 acre in size and were duplicated. Plots were separated by 19-inch alleys of sod. Carpet grass was planted from seed; Bermuda grass and centipede grass were set from runners.

Fertilizer was applied each year, all in the spring, unless otherwise indicated in table 26.

Cuttings were made during the grazing season at 3-week intervals with a power lawn mower.

The experiment was conducted continously on the same land, the treatment of each plot being the same each year.

The 4-year (1931-34) average rainfall for the period March 1 to October 1 was 32.77 inches, and the average annual rainfall for the 4-year period was 43.24 inches.

Reference: United States Department of Agriculture, Agricultural Adjustment Administration Bulletin SRAC-5, "Permanent Pastures," pages 47 and 48, table 31, Washington, D. C., June 1938.

Lowland Permanent Pasture Fertilizer Test

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1931-40.

Purpose: To determine the effect of various fertilizer treatments on beef cattle gains on lowland pastures.

Soil: Plummer sandy loam.

Land history: Originally the land was covered with dense swamp growth consisting of pine, black gum, poplar, gallberries, groundsel, briars, and wiregrass.

Procedure and conditions: Clearing and draining was started in 1926. At that time only one pasture was completed, namely, the carpet grass-lespedeza pasture which had been used as a check, or unfertilized area.

In 1928 and 1929 continuation of this work was carried on north of and adjoining the original area, and in the spring of 1929 four more pastures were seeded. The new seeding consisted of a mixture of carpet grass 8 pounds, Dallis grass 4 pounds, lespedeza 10 pounds, and white clover 3 pounds per acre. Later data indicate that a better stand and quicker sod is secured by planting carpet grass 10 pounds, Dallis grass 8 pounds, common lespedeza 12 pounds, and white clover 5 pounds per acre. Fertilizer was applied but no grazing was possible the first year for lack of fence. In 1930 grazing was carried on but no records kept except for pasture number one. Pastures were gone over and reseedings made on bare spots the following spring.

Fertilizer was applied for each pasture. All of the superphosphate and potash and one-half of the nitrogen was put on about the middle of March. The other half of the nitrogen was applied around July 20. The materials used were superphosphate, muriate of potash, and nitrate of soda, without making comparisons with other sources of fertilizer.

The number of steers on a pasture was kept the same throughout the year when possible. Sometimes weather conditions made it necessary to add or remove an animal or two. Under these circumstances weights were taken and the pasture given credit for the gain or loss.

Pasture upkeep consisted of the fertilizer application and two or three mowings each year.

For the 5-year period previous to 1936 the lowland pastures, except the check, received fertilizer every year as indicated below. In 1936, only nitrate of soda was applied to pastures where nitrogen was in the formulas, the plan being to apply nitrogen every year, but phosphate and potash only every third year. Fertilizers are expressed in ammonia, phosphorus and potash (NPK) in the order named. Nitrates are figured on ammonia basis. (Ammonia is equivalent to 82.3 percent nitrogen.)

The series of lowland pastures is numbered as follows:

1. Lowland permanent pasture of carpet grass and lespedeza which received no fertilizer. (Check pasture).

2. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds

6-12-6 fertilizer per acre each year through 1935. After 1935 complete fertilizer was applied every 3 years except the nitrogen part of the formula which was applied every year.

3. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds 6-12-0 fertilizer per acre each year through 1935. After 1935 phosphate fertilizer was applied only every 3 years and nitrogen was applied every year.

4. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds 6-0-0 fertilizer per acre each year.

5. Lowland permanent pasture of carpet grass, Dallis grass, lespedeza and white clover which received 600 pounds 0-0-6 fertilizer per acre each year through 1935.

Table 27. Fertilizer test on lowland permanent pastures, Georgia, 10-year average, 1931 to 1940, inclusive.

	Average no. steers grazed	Average initial weight, pounds	Average final weight, pounds	Average gain-per steer pounds	Average gain in animal liveweight per acre pounds
6 acres, carpet grass* No fertilizer (Pasture No. 1)	4.8	445.9	549.3	103.6	81.8
6 acres, mixture** 600 lbs. 6-0-0 fertilizer*** per acre (Pasture No. 4)	6.1	459.3	600.3	140.3	140.3
3 ½ acres mixture** 600 lbs. 0-0-6 fertilizer*** per acre (Pasture No. 5)	3.7	456.0	604.9	148.9	152.5
6 acres mixture** 600 lbs. 6-12-0 fertilizer*** per acre (Pasture No. 3)	8.8	458.0	660.9	202.8	290.9
6 acres, mixture** 600 lbs. 6-12-6 fertilizer*** per acre (Pasture No. 2)	8.9	465.9	685.9	220.11	320.3

*Ten-year average, 1930 through 1940; no record for 1935.

**Pasture mixture consists of carpet grass, Dallis grass, lespedeza and white clover.

***Ammonia, phosphoric acid, and potash in the order named. Fertilizer applied annually through 1935. Fertilizer applied since 1935 every third year except plots containing nitrogen which is applied every year.

Pasture number one which received no fertilizer was principally carpet grass. The sod was so compact that very little lespedeza remained after 1931. No tests were conducted in this pasture in 1935 because part of the pasture was plowed to destroy patches of sedge and wiregrass.

Reference: Georgia Coastal Plain Experiment Station Bulletin 27, "Pastures for the Coastal Plain of Georgia," pages 22, 23, and 24, table 6, Tifton, Georgia, June 1942.

Upland Permanent Pasture Fertilizer Tests

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1932-40.

Purpose: To determine the effect of complete fertilizer on Bermuda grass and common lespedeza pasture.

Soil: Norfolk and Tifton sandy loam.

Procedure and conditions: One-third of this pasture was turned each year to keep Bermuda grass from becoming sod-bound, to control unpalatable weeds, and to cover croppings of manure.

In turning this land a two-horse plow was used in early March. When an area was turned a seeding of lespedeza —12 to 15 pounds per acre—followed immediately because where land was completely turned lespedeza seed were covered too deep for reseeding.

The above cultural practice means a turning of Bermuda sod every 3 years and also a seeding of lespedeza every 3 years immediately after the turning operation.

Flat breaking the land encouraged the growth of some weeds like Florida pursley, Richardia scabra, and crab grass, Digitaria sp., but these are palatable weeds and cattle grazed them freely. Palatable weeds of this type are not a serious pest and seldom require mowing.

Before the spring of 1936 this Bermuda pasture received no fertilizer. Beginning in 1936, 600 pounds of 6-12-6 fertilizer per acre were applied. This pasture received phosphorus and potash every third year, while the nitrogen was applied every year, one-half in the spring and one-half in the summer.

In 1934, a very low gain of 59.6 pounds per acre was recorded. It will be noted that 10 steers were used and the

Table 28. Effect of complete fertilizer on Bermuda grass and common lespedeza pasture, 12 acres.

	1932	1933	1934	1935	1936	1937	1938	1939**	1940	9-yr. Av.
Grazing started	Apr30	Apr4	Apr4	Apr3	Apr8	Mar30	Mar22	Mar29	Apr3	
Grazing finished	Nov14	Nov14	Nov13	Nov5	Nov11	Nov2	Nov1	Nov1	Oct16	
Number steers grazed -----	5	8	10	9	6	8	11	10	10	8.6
Average initial weight, lbs. --	407	412	444	457	510	552	455	491	430	462.0
Average final weight, lbs.----	716	588	516	636	729	747	582	686	586	642.9
Total gain live-weight, lbs.----	1543	1402	716	1605	1316	1556	1393	1944	1562	1448.6
Av. lbs. gain per steers, lbs. -	308.6	175.4	71.6	178.3	219.3	195.0	127.0	194.4	156.2	180.6
Gain in annual liveweight per acre, lbs. ----	128.6	116.8	59.6	133.7	131.6*	155.6*	116.0	162.0	130.2	126.0

*Ten acres.

**Years in which complete fertilizer was applied.

pasture was obviously over-grazed before being completely sodded. It appears that 12 acres gave about the right amount of grazing for 8 to 10 animals after the sod was well established, or the carrying capacity was approximately three-fourths animal per acre. Table 28 shows the results over a 9-year period.

Reference: Georgia Coastal Plain Experiment Station Bulletin 27, "Pastures for the Coastal Plain of Georgia," pages 43 and 44, table 17, Tifton, Georgia, June 1942.

Fertilizing Permanent Pastures

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1931-40.

Purpose: To determine the effect of various fertilizers on beef production.

Land history: Originally the land was covered with scattered timber, briars and bushes. It was cleared, stumped and drained with a central open ditch and lateral ditches along the edge of the lowland to cut off hill seepage water where necessary.

Soil: Plummer sandy loam.

Procedure and conditions: At the beginning of this test, 1931 through 1935, the lowland permanent pastures re-

Table 30. Lowland permanent pasture, fertilizer tests, Georgia, 10-year average, 1931 to 1940, inclusive

	6 acres carpet grass no fertilizer	6 acres mixture* 600 lbs. 6-0-0 fertilizer** per acre	3½ acres mixture* 600 lbs. 0-0-6 fertilizer** per acre	6 acres mixture* 600 lbs. 6-12-0 fertilizer** per acre	6 acres mixture* 600 lbs. 6-12-6 fertilizer** per acre
Av. no. steers grazed	4.9	5.97	3.70	8.72	8.73
Av. initial weight, lbs.	454	460	456	458	466
Av. final weight, lbs.	547	598	605	661	686
Av. gain per steer, lbs.	93	138	149	203	220
Av. liveweight gain per acre, lbs.	76	141	153	291	321

*Pastures mixture consists of carpet grass, Dallis grass, common lespedeza and white clover.

**Nitrogen, phosphoric acid, and potash in the order named.

Note: Results for 1935 on 6 acres of carpet grass without fertilizer not included.

ceived nitrogen, phosphate, and potash. One-half of the nitrogen was applied in the spring about March 15, and the remaining one-half as a top-dressing about July 20. After 1935, the nitrogen was applied each year while phosphate and potash were applied only every third year.

Animals used for grazing were grade Hereford steers averaging about 400 pounds when put on pastures. They were kept on the pasture continuously through the grazing period without any other feed. A mineral mixture of marble dust (lime), steamed bonemeal (phosphate), and salt, in equal parts, was kept available to the steers at all times. The steers were weighed at regular 4-week intervals.

Reference: Georgia Coastal Plain Experiment Station Bulletin 32, Twenty-First Annual Report, pages 43, 44, and 45, table 25, Tifton, Georgia, July 1941.

Fertilizing Carpet Grass-Lespedeza Pastures

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1936-39.

Purpose: To determine the effect of applications of lime with and without phosphorus and basic slag on carpet grass-lespedeza pasture in terms of beef produced per acre.

Soil: Coastal Plain relatively high in acidity and correspondingly low in phosphorus and calcium.

Table 31. Relative beef-producing capacities of coastal plain pastures receiving different treatments, grazing data; South Carolina, 1936-1939

	Pasture*				
	CL-1	CL-2	CL-3	CL-4	BS-5
Acres	15	15	15	15	--
Treatment	None	2000 lbs dolomitic lime every third year	2000 lbs. dolomitic lime every third year, 250 lbs. 16 percent superphosphate annually	1500 lbs. basic slag every third year	Burned annually
Carrying capacity steer days per acre	83.1	84.9	110.3	111.7	27.6
Beef produced per acres, lbs	4.93	30.80	34.60	40.25	2.53
Average daily gain per steer, pounds	0.059	0.358	0.405	0.420	0.091

*CL=Carpet-grass-lespedeza
BS=Native broom sedge

Procedure and conditions: Five separate pastures, each receiving a different treatment as shown in table 31 are being used in the comparison. All pastures are grazed according to their carrying capacity throughout the pasture season with feeder steers. Data as to carrying capacity and beef produced per acre have been recorded for four consecutive trials. In addition to these data, caged areas are clipped at regular intervals, weights recorded, and samples of the herbage retained to be analyzed for feed value and mineral content. Table 31 includes the grazing data for the 4-year period, 1936-1939.

Reference: South Carolina Station Report for 1940, page 103, table 47, Clemson, South Carolina, December 1940.

Fertilizing Pastures in Louisiana

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Ringgold, Louisiana.

Period: 1941-42.

Purpose: To determine the effect of various fertilizers on the yield of hay and beef gains.

Land history: Land had been planted to cotton for many years and yields had reduced to a very low point.

Soil: Ruston fine sandy loam.

Procedure and conditions: On the farm of E. C. Parker, at Ringgold, a field of 21 acres, formerly in corn and cotton, was divided into three pastures of 7 acres each. One field received one-half ton of lime per acre and 300 pounds of mixed (3-12-8) fertilizer. One field was left unfertilized and one was treated with 300 pounds of 3-12-8 fertilizer without lime. The pastures were seeded with Bermuda grass, Dallis grass and white Dutch clover, black medic, hop clover, and common lespedeza. An adjoining field, No. 4 (9.7 acres) then in pasture, was replowed, treated with 400 pounds of basic slag per acre and seeded with Dallis grass, white Dutch clover, and lespedeza.

An excellent stand of lespedeza was produced on all fields in the summer of 1941.

In the spring of 1942, pasture 4 (basic slag), carried 30 head of yearling cattle on 9½ acres from April 4 to May 1 and from July 7 to August 7, a total of 58 grazing days.

The lime and fertilizer plot seem to have the poorest soil of the first three plots. Evidently Mr. Parker had been using fertilizers in the past years on all this area and there was evidently some initial effect of previous fertilization in field 2. The results are not shown for 1943; however, another half ton of lime per acre was added on the lime field and 300 pounds of 0-14-14 per acre on fields 1 and 3.

In 1944 the unfertilized pasture showed up more poorly than in previous years and the lime plot proved to be in

Table 32. Fertilizing pastures on E. C. Parker farm, Ringgold, Louisiana, 1941-42.

	Pasture			
	1	2	3	4
Fertilizer treatment	1000 lbs. lime 300 lbs. fert.	none	300 lbs. fertilizer	basic slag
Grazing period, 1941	July 21 to November 1	same	same	same
Grazing period, 1942	April 1 to November 1	same	same	58 days
Gain per acre, pounds beef, 1941	153	156	225	......
Gain per acre, pounds beef, 1942	187	185	212	202
Average gain for 2 years, 1941-42, pounds	170	170.5	218.5	......
Hay yields per acre 1942, pounds	1100	770	1685	......

much better condition than ever before. In October the lime field still looked green while the unfertilized field was brown.

The basic slag field, number 4, is not strictly comparable to the other fields. It seems to be a poorly drained soil and what is known as "crawfishy".

Reference: Louisiana Agricultural Experiment Station, Station Annual Report, 1941-1942, pages 40 and 41; Louisiana Experiment Station Cir. 42, 1942, "Beef Cattle Pastures on Hill Cotton Lands and Cutover Lands in Louisiana." Also letter to author from Mr. Charles I. Bray, Animal Husbandman, Louisiana Agricultural Experiment Station, October 23, 1944.

Fertilizing Pastures in Louisiana

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Lake Charles, Louisiana.

Period: 1944.

Purpose: To compare the effect of different fertilizer treatments on beef gains.

Soil: Calcasieu.

Procedure and conditions: A number of these pastures were undergrazed, although the check field was probably eaten down lower than the others. At one time the No. 1 lot broke through into the No. 2 field, but just for how many days we do not know. It seemed that in field 6 there was a much heavier growth of coarse grass than in the next field with Ca Metaphosphate alone or in any of the others. A large amount of sedge and other unpalatable grasses were present on these pastures.

Table 33. The Effect of different fertilizer treatments on beef gains, Lake Charles, Louisiana, 1944

Lot	Treatment	Gain per acre
1	None	67.5
2	Lime—1 ton Ca Metaphosphate 100	138.5
3	Superphosphate 300	115.5
4	Complete fertilizer 500	94.5
5	Ca Metaphosphate 100	123.5
6	Ca Metaphosphate 100 Muriate of potash	101.5

Reference: Letter from Charles I. Bray, Animal Husbandman, Louisiana State University, dated November 7, 1944.

Fertilizing Pastures to Control Broom Sedge

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: Middle Tennessee Experiment Station, Columbia, Tennessee.

Period: 1928-1933
1928-1934

Purpose: To determine the effect of pasturing and use of legumes on control of broom sedge.

Soil: Maury silt loam, brown-colored and of good fertility.

Procedure and conditions: In 1927 the Middle Tennessee Experiment Station began a study of broom-sedge eradication. It was necessary to secure a stand in order that control measures might be brought into use. An area was well prepared and seeded to broom sedge in the early part of the year. Bluegrass and white clover were sown with the sedge, and good stands of all were obtained. A leased acreage, already well established in broom sedge, was added in 1928, and eradication methods were started.

In both cases the land on which broom-sedge-control methods were used is so well supplied with phosphoric acid that no effects have ever been noted from additional applications of this plant food. Therefore, the use of a phosphate fertilizer was left out of consideration; and for a similar reason potash fertilizer was not used. It was assumed from the results of other experiments that the main soil deficiencies were nitrogen and lime.

The area sown was divided into four equal plots. One, a check plot, was left in the sedge grass, with the bluegrass and white clover. Common lespedeza was sown over a second plot, hop clover over a third, and sweet clover over a fourth. One-half of each plot was limed. Notes on stands were taken, beginning in 1928, and are recorded in table 35. Pasturing was started in 1929 and continued from year to year through 1933. It should be noted here that white clover soon disappeared and was not an important factor.

Always it was the aim to pasture all plots closely in the spring and early summer. Later in the season, when the grass grew up again, use was also made of this growth. In 1929 and 1930 the sedge-grass plots were pastured so closely that no gains in weight per acre were made by the cattle. However, in 1931, 1932 and 1933, the average gains in weight per acre were very satisfactory. The gains on the check plot, where the sedge grass had no companion crop except bluegrass and a trace of white clover, were 150 pounds of beef per acre. The average gain per acre on the hop clover plot was 200 pounds. These were very satisfactory gains, especially when it is remembered that 1931 was the year of the severe drouth. Lime had but little effect except on the sweet clover plot. Had there been more white clover, the lime would have proved of greater value.

In 1928 approximately an acre of land that was covered with broom sedge was leased for making further control studies. This was old crop land that had been seeded down to mixed pasture for several years but had become well set with sedge grass. Very little of the grass mixture was left. On this particular acre there were some hop clover and wild onions and a little common lespedeza.

The sedge grass was mowed and raked off, the land was disked and harrowed to make a seedbed, and a mixture of bluegrass and white clover was sown. The year was favorable, and a good set was established. The mower was used on this acre and surrounding parts of the field often enough to prevent sedge grass from forming seed. Three mowings were required that year, but usually two were enough, and when combined with pasturing, sometimes one mowing was sufficient.

A portion of land was manured with stable manure at the rate of 6 tons per acre at the outset and again in 3 years. Another area was treated annually the middle of March, with 200 pounds of nitrate of soda, and still another with 150 pounds of sulfate of ammonia. A larger amount of land was left untreated. The entire area was mowed at the same time and pastured the same way. In 1929, pasturing with young cattle was begun, the mower being used to take care of the broom sedge that was left. The cattle were weighed on and off the area, so that gains could be determined. Also a record of the number of days they were carried was computed on the basis of 1,000-pound animals. The results in getting rid of sedge grass are given in tables 34 and 35.

Table 34. Percentage of sedge grass on the basis of 100 percent for a full stand, Tennessee, 1936.

Year	Sedge grass			
	Check plot	Lespedeza plot	Hop clover plot	Sweet clover plot
	Percent	Percent	Percent	Percent
1928	95	95	95	95
1930	35	25	30	20
1932	35	25	11	17
1933	35	20	5	15

Table 35. Percentage of sedge grass under various treatments, on the basis of 100 percent for a full stand, Tennessee, 1936.

	Sedge Grass			
Year	Check plot mowed and pastured	Manure, 6 tons per acre each 3 years	Nitrate of soda, 200 lbs. per acre per year	Sulfate ammonia 150 lbs. per acre per year
	Percent	Percent	Percent	Percent
1928	90	90	90	90
1930	54	40	38	43
1932	15	Trace[1]	Trace[1]	Trace[1]
1934	15	0.034	0.08	0.2

[1] Trace is less than 5 percent.

Reference: Tennessee Agricultural Experiment Station Circular No. 57, "Control of Broom Sedge," Knoxville, Tennessee, February 1936.

Lime and Fertilizer Distributing Equipment

One of the major problems many Mississippi farmers have in fertilizing and liming pastures, is the matter of getting this material distributed on the land. Several types of distributing equipment are shown below. Two of the types, namely the knocker type and the whirler type, can be made in the average community farm shop. The former is fastened to a regular 2-horse wagon body and the cost of materials is only a few dollars. The latter is made from the rear axle of an old automobile and some additional sheet steel and angle or strap-iron which can usually be secured from junk yards. This spreader costs a few dollars more than the former type but rarely ever exceeds $35.00 for cost of materials excepting rubber tires.

These two lime or fertilizer spreaders are used in Mississippi principally by small farmers or farmers with small pastures who can not justify the purchase of high cost spreaders.

Many farmers in Mississippi with large pastures use some type of commercial spreader similar to those shown in figures 5, 6, and 7. This is probably true because they are easier to operate and material can be distributed faster, yet the cost per acre is not prohibitive due to large pasture acreages involved.

Detailed blueprints with bill of materials and specifications may be secured from the Mississippi Agricultural Extension Service, State College, Mississippi for the spreaders shown in figures 2, 3 and 4. Persons desiring these blueprints may write directly to: Mississippi Agricultural Extension Service, Agricultural Engineering Department, State College, Mississippi.

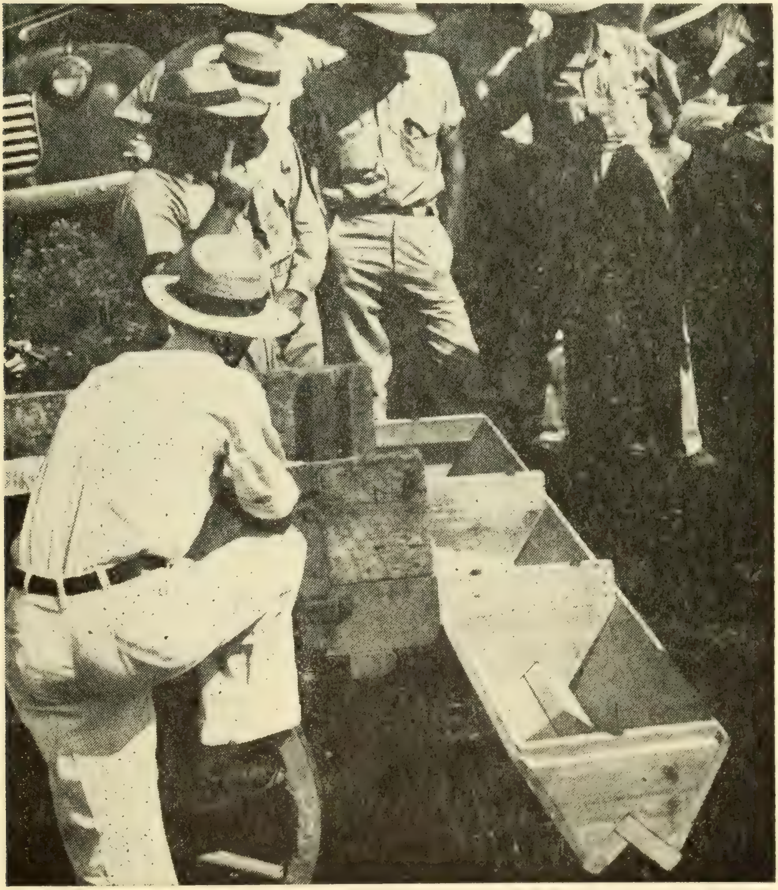

Figure 2. Knocker type lime spreader.

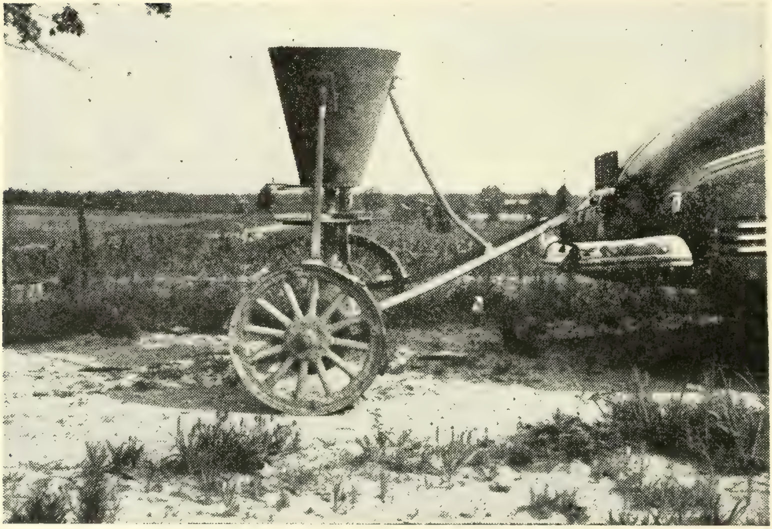

Figure 3. Whirler type lime spreader.

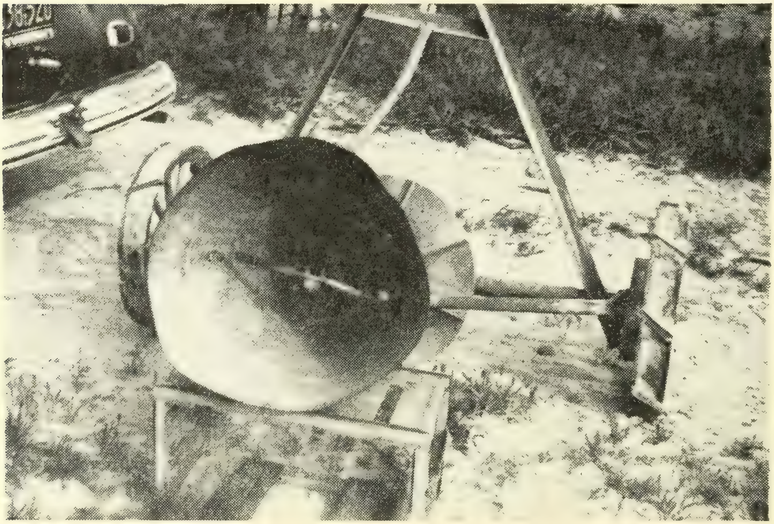

Figure 4. Whirler type lime spreader.

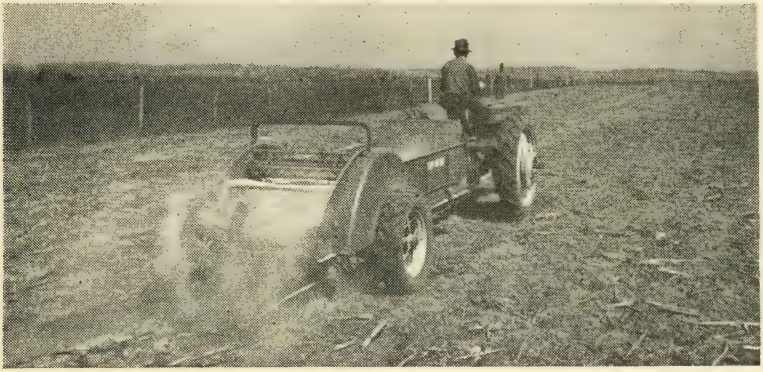

Figure 5. Commercial type lime spreader.

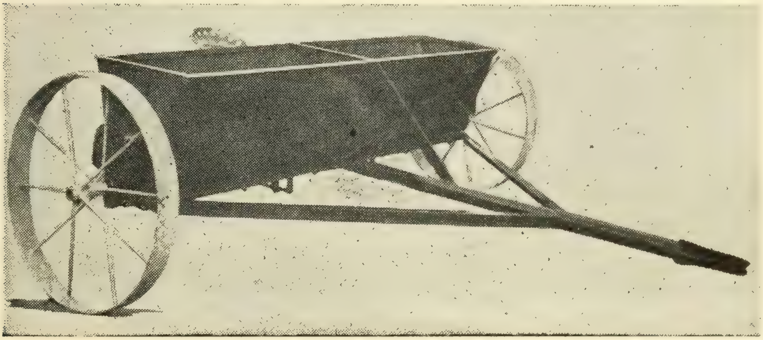

Figure 6. Commercial type lime spreader.

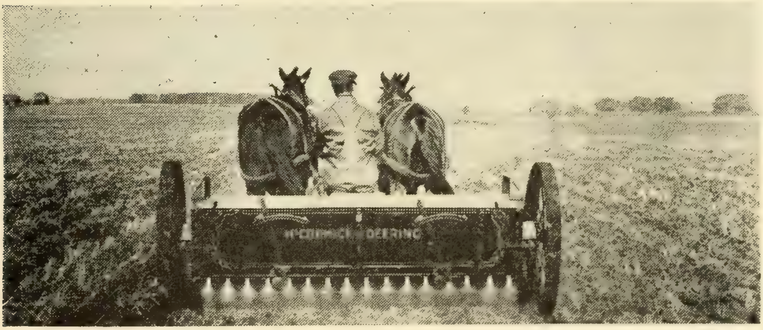
McCORMICK-DEERING

Figure 7. Commercial type lime spreader.

PART VI

SEEDING PASTURES

Study of Plants Found Before and After Seeding and Seeding Practices

Brown Loam Area. Table 36 below shows a summary of the most common pasture plants found before any seeding was done, the plants that were seeded, and the number of farms on which satisfactory stands were found at the time of this study which was from 1 to 4 years after seed were sown. This study was made on 23 farms in the Brown Loam Area.

In practically all cases seedings and other improvements were made on old established pastures; that is a sod of some kind was present on the land before treatments were made.

Dallis grass, white Dutch clover, and lespedeza were the principal plants seeded in the Brown Loam Area on the farms studied. However, yellow hop was sown on five farms. The first three plants mentioned, along with Bermuda, were found on a large percentage of the farms at the time of the study.

Notations made at the time of the surveys, show that the satisfactory stands of Dallis and white Dutch clover were most often found on the more fertile and moist soils. On the other hand, satisfactory stands of lespedeza and hop clover were found on the higher and thinner soils. In

Table 36. Grasses and clovers present before and after seeding, Brown Loam Area

Pasture plants	Number of farms on which:		
	Plants were found before seed were sown	Seed were sown	Satisfactory stands were found at time of study (after seed were sown)
Dallis grass	1	19	17
Bermuda grass	15	0	15
Carpet grass	13	0	6
White Dutch clover	1	23	20
Lespedeza	10	18	15
Yellow hop clover	0	5	6
Broom sedge	3	0	0

addition, Bermuda grass was found more often on the terrace and hill soils. The Bermuda grass, however, may have been established previous to the time that the land was put to pasture; at least it was established on 15 farms before and the same number after seedings and other treatments were made. It should be noticed that with the use of seedings, fertilizer and other improvement practices, carpet had a tendency to fade out. Broom sedge disappeared completely.

On the higher and thinner soils grazing was found to be very poor during the dry fall season of 1944. In view of this fact, a few farmers had planted lespedeza sericea, and indications are that this plant will survive the drought on upland soil and provide fair to good grazing. The plant is not highly palatable but cattle were eating the sericea when other plants were not available and they were eating it much better when the plants were young and tender. It was necessary to mow the sericea at regular intervals unless it was grazed closely in order to keep the plants from getting too large, weedy, and unpalatable. However, lespedeza sericea probably has not been used long enough as a pasture plant to determine whether or not it is desirable or successful as such. On the other hand, it may offer some promise for additional grazing during droughty seasons on upland soils.

South Mississippi Area. Table 37 shows a summary of the most common pasture plants found before seeding and other improvement practices were made, also the plants that were seeded and number of farms on which satisfactory stands were found after treatments were made according to each plant listed. This check was made on 32 farms in 7 different counties in South Mississippi.

Only a few of the pastures checked were new pastures at the time seeding and other improvement practices were done, the majority of them being old pastures already established with a sod from native pasture plants.

The principal plants in these pastures before any seeding or other improvement practices were made, were carpet grass and lespedeza. A few of the pastures had Bermuda and broom sedge. A large percentage of these pastures were then seeded to Dallis grass, white Dutch clover, and lespedeza, while yellow hop was sown on slightly less than one-third of the farms. Bermuda and carpet were sown on only two farms.

After seeding and other treatments were given, Dallis grass, carpet grass and white Dutch clover were found on about the same number of farms, or approximately 20; however, the white Dutch and Dallis were always found on the lower, more moist and fertile soils. Lespedeza was found on more farms than any other plant, or 28 of the 32 farms. Carpet and lespedeza were found more often on the higher and less fertile soils, although, some lespedeza and carpet were found on the lower soils. It should be pointed out again, as was the case in the Brown Loam Area, that broom sedge faded out completely with the use of pasture improvement practices.

Table 37. Grasses and clover present before and after seeding, South Mississippi Area

Pasture Plants	Number of farms on which:		
	Plants were found before seed were sown	Seed were sown	Satisfactory stands were found at time of study (after seed were sown)
Dallis grass	1	29	20
Bermuda grass	4	2	11
Carpet grass	24	2	23
White Dutch clover	1	26	20
Lespedeza	15	23	28
Yellow hop clover	1	9	7
Broom sedge	5	0	0

Northeast Mississippi Area. Table 38 shows a summary of the seeding practices and pasture plants found before and after seeding, along with other pasture improvement practices on 20 farms in Northeast Mississippi.

Again, as in the case of other areas, seeding and other pasture improvement practices were done in most cases on old established sods or pastures.

Table 38. Grasses and clover present before and after seeding, Northeast Mississippi Area

Pasture Plants	Number of farms on which: Plants were found before seed were sown	Seed were sown	Satisfactory stands were found at time of study (after seed were sown)
Dallis grass	7	18	18
Bermuda grass	13	1	11
Carpet grass	6	3	4
White Dutch clover	2	16	15
Lespedeza	13	15	16
Yellow hop clover	0	1	4
Broom sedge	1	0	0

Table 38 shows that the principal grasses found prior to the use of pasture improvement practices were Bermuda, Dallis and carpet, although Bermuda was found on as many farms as both Dallis and carpet. The principal legume found on these pastures was lespedeza. Lespedeza, white Dutch clover and Dallis were sown on over three-fourths of the farms checked, while Bermuda, carpet, and yellow hop were sown on a few of the farms.

After this seeding was done, along with fertilizing and other pasture improvement practices shown on page 16, table 3, satisfactory stands of white Dutch clover, lespedeza, and Dallis grass were found on 15, 16, and 18 of the 20 farms, respectively. It should be pointed out again that broom sedge faded out of the picture and carpet grass had a tendency to fade out. However, table 3 shows that better than 40 percent of the pasture land was in bottoms and notes made at the time of the surveys, show that on practically all of the 20 farms studied the hill land devoted to pasture was high in fertility compared to the other hill lands in that area as well as other sandy land areas. This may be due to the fact that most of the surveys were made in an area where intensive dairying is done and farmers are very much interested and feel that it is necessary to have good pastures.

Prairie Area. Only 11 farms were surveyed in the Prairie Area and they were not typical farms for that area as to soil type and size or number of acres in pasture, more especially as to soil type. Therefore, the seeding practices and the plants found before and after seeding and other pasture improvement practices are not shown here in tabular form. Of the 11 farms studied, white Dutch clover, lespedeza and Dallis grass were sown on about three-fourths of the farms and the same three plants were the principal ones found in satisfactory stands after seeding and other improvement practices were made, Bermuda and yellow hop being found on only about 33 percent of the pastures.

Discussion of Various Pasture Plants and their Establishment*

Dallis Grass

Dallis grass is a fast-growing perennial bunch grass with a deep root system. It produced many basal leaves, which, following grazing or drought, makes a more rapid recovery than any other of our pasture grasses. It is propagated by seed produced on long (1 to 4 feet), upright seed stalks. It grows over a long season, being the first of the summer grasses to begin growth in the spring and the last to be frosted in the fall. In the spring it will furnish good grazing several weeks earlier than Bermuda.

This grass is adapted to a wide variety of soils. It makes its best growth on bottomland soils because of more soil fertility and soil moisture. It will thrive on lower land than carpet grass, and will grow higher on the hills. It is more tolerant to excessive soil moisture, and at the same time is more drought resistant than Bermuda or carpet grass. It grows well on all soils except the extremely sandy ones.

Dallis grass, being a bunch grass, grows in clumps and will not completely cover the soil with a dense sod. However, this is an advantage in that it makes Dallis particularly adapted to associated growth with other desirable pasture plants, especially the legumes. This may be shown by the results of a greenhouse experiment run on three soils with Dallis grass and white Dutch clover.

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*By Dr. H. W. Bennett, Associate Agronomist, Mississippi Agricultural Experiment Station, State College, Mississippi.

Association with clovers. Used in this test was Sarpy sandy loam, a fertile Delta soil; Grenada silt loam, a medium-fertile hill soil of the Brown Loam Area; Ruston sandy loam, a medium-fertile soil of the Coastal Plains. The analysis of the soils used is as follows:

Soil type	Percent nitrogen N_2	Percent calcium	pH
Sarpy sandy loam	0.061	0.74	6.5
Grenada silt loam	0.101	0.32	6.2
Ruston sandy loam	0.048	0.31	6.1

Two series of plots were used on each of the three soil types. One series of plots consisted entirely of Dallis grass plants. The other series of plots consisted of Dallis grass and white Dutch clover plants growing in combination. This combination contained the same total number of plants, as the grass plots, but one-third of the total number were Dallis grass plants and the other two-thirds of the total number were white Dutch clover plants. For every three Dallis grass plants growing on one series of plots there was one Dallis grass plant and two white Dutch clover plants growing on the series of plots having the grass and clover combination. Thus, each plot on each soil type contained the same number of plants regardless of whether this total number was made up of grass plants alone or of a combination of grass and clover plants.

Table 39. The effect of clover association on the yield of Dallis grass

Crop	Yield of dry matter per acre on three soils		
	Sarpy	Grenada	Ruston
Dallis grass alone	8910.2	9458.0	7258.9
Dallis grass of the association	7346.9	6978.7	6442.5
Clover of the association	1996.2	1807.5	1866.6
Total yield of the Dallis grass and white Dutch combination	9343.1	8786.2	8309.1

The yield of dry matter produced per acre of five cuttings is shown in table 39.

Establishing Dallis grass.* Along with the advantages, however, Dallis grass has the disadvantage of being difficult to establish by ordinary methods of seeding. This is due to seed of a low percentage germination and to ineffective methods of seeding. That Dallis grass can be successfully established in spite of low quality seed has been shown by tests of methods of seeding pasture grass conducted by the Mississippi Agricultural Experiment Station.

Seeding 8 pounds of domestic Dallis grass seed per acre under varying practices gave the following results.

Table 40. The effect of the method of seeding on the stand of Dallis grass

Method of seeding	No. plants per square foot
Broadcast -- No preparation	0.5
Mulched -- No preparation	6.0
Prepared -- Open furrows	5.0
Prepared -- Open furrows -- Harrowed	9.0

From the results shown in the table, it may be seen that soil preparation very materially increased the stand of grass, and that the increase in stand was in proportion to the amount of preparation. When seed were slightly mixed with soil there were nearly twice the number of plants as where planted in open rows without mixing. Preparation by open furrows only was 10 times as effective as no preparation. Seeding broadcast, as is ordinarily done, gave only one plant every 2 square feet. This test shows clearly the advantage of preparation if it be nothing more than a furrow to hold the seed in place.

It should be kept in mind that most pasture grass seed are slow to germinate. The time necessary to obtain an official germination test for Dallis and Kentucky bluegrass is 28 days. Therefore, any method of seeding should provide that the seed should lay where they fall when sown. Herein lies the advantage of mulching, or of planting in a furrow, and of lightly covering the seed in the furrow by harrowing.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," pages 9, 10, and 11, table 3, State College, Mississippi, July, 1941.

Probably the most significant result of this work is the stand obtained by means of mulching. Where mulched, there were 12 times more plants than when planted broadcast. This is a very satisfactory method of establishing Dallis grass. Excellent results have been obtained when mulching has been done at the rate of 1 ton of cut material per 3 acres.

Methods of seeding. Where extreme difficulty in establishment is anticipated or experienced, a practical procedure is to:

(1) Thoroughly prepare an area.

(2) Sow 6 to 8 pounds per acre of Dallis grass seed in narrow rows and harrow lightly.

(3) Allow to mature seed.

(4) Mow and scatter the entire mass where Dallis grass is desired, at the rate of 1 ton of the cut material to 3 acres.

The same satisfactory results may be obtained by protecting already existing stands against grazing and weed growth, and mowing and scattering the cut material in the same manner.

Excellent results have also been obtained by sowing 4 to 6 pounds of seed in scooter furrows spaced 3 to 4 feet apart and allowing the resulting Dallis grass plants to seed and fall over. In test plots where plants were spaced 2 feet apart in rows which were 3 feet apart and allowed to seed, there was produced the next spring a stand of 15 plants per square foot.

These seed tests have led to the following recommendations:

(1) Where possible, sow Dallis grass on a prepared but firm seedbed in narrow rows, and lightly harrow.

(2) If sowing for the first time on old pasture, run shallow furrows 3 to 5 feet apart, and sow seed in the furrow.

(3) Where material from a cut-over Dallis grass area is available, mulch new areas where Dallis is desired at the rate of 1 ton for every 3 acres.

Dallis grass should be seeded from September to May. Like Bermuda sodding, the supply of moisture is more important than the time of seeding, and early seeding permits the establishment of plants while moisture is usually abundant. Mulching may be done at the time of cutting mature Dallis grass. Under any method of seeding it is extremely important that Dallis plants be allowed to become fully established before heavy grazing or mowing is done. A good practice to follow is to allow seed stalks to begin showing before permitting heavy grazing.

Bermuda Grass

Bermuda is a low, sod-forming, perennial grass. It is commonly propagated by means of both surface runners and underground rootstocks. These growth characteristics make it our best soil conserving crop and at the same time a serious pest where not wanted. It is at present the most widely used permanent pasture grass in the State.

Bermuda grass is adapted to practically all soils in the State that are fairly well drained and not extremely poor. Bermuda, like Dallis, is able to make creditable growth only on soils of at least a fair level of fertility.

Bermuda grass makes excellent pasturage when young and succulent. With the coming of summer or droughty conditions it soon becomes fibrous and unpalatable.

Establishing Bermuda grass.* Bermuda is propagated principally by means of sod parts. The recommended method is to place pieces of sod at 3 to 4-foot intervals, or to scatter sod parts and cut in with a disk. This method is costly, requires a long time for establishment and success is dependent upon moisture conditions.

Good stands of Bermuda grass are usually difficult to obtain by means of seed. Early planting is mandatory for establishment, inasmuch as considerable growth must be made for the grass to develop storage organs. Seedings should be made lighter than formerly recommended and thus reduce competition between the young seedlings. Seed 3 to 5 pounds per acre.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," pages 13 and 14, State College, Mississippi, July, 1941.

Whether seeded or sodded, Bermuda must be given time to establish itself. Grazing soon after germinating or sprig sodding will weaken the plants and prevent formation of enough rootstocks for complete ground coverage. Recently sodded areas should be grazed lightly, if at all, to permit complete coverage of the ground. One to 2 years are necessary for the establishment of a full sod.

Were it not for expensive establishment, lack of drought resistance, becoming fibrous soon in the season, and were it not a pest where fields are to be rotated, Bermuda would be our best summer pasture grass.

Carpet Grass

Carpet grass is also a low, sod-forming, perennial grass. It is propagated by seed and by creeping plant parts. Being adapted to moist bottomlands, carpet grass forms a dense sod which is difficult to eradicate. Too, the density of the sod makes it extremely difficult for other pasture plants to grow in combination with carpet grass.

Pastures in areas where conditions are favorable for the growth of carpet grass, as in South Mississippi, usually have only this grass for grazing.

Establishing carpet grass.* Seedings of carpet grass, like Bermuda and Dallis, must be given time for establishment. Seedings at the Natchez Branch Experiment Station have shown that it takes 2 years for establishment by means of seed, even when sown on a prepared seedbed at the rate of 15 pounds per acre. So prevalent is this grass in regions of South Mississippi, however, that clearing the land of trees and brush results in complete ground coverage the second year without seeding.

White Dutch Clover

White Dutch clover is the best spring pasture clover for the majority of Mississippi pastures. It is a shallow rooted, perennial plant that creeps on the surface and takes root at the joints. This clover gives grazing over a longer period than any other of our spring clovers because of its indeterminate habit of growth—growing, blossoming, and seeding at the same time. It seeds profusely throughout its growing season, and with the coming of dry weather will lie dormant until moisture conditions are favorable when it again begins growth, blossoming, and seeding. The other pasture clovers, being determinate in their habit of growth, finish their growth when they have seeded. This plant habit often causes white Dutch to yield more plant material per acre than many other more upright growing clovers.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 14, State College, Mississippi, July 1941.

White Dutch clover is adapted to all soils of the State where moisture is sufficient for its growth, its first requirement being a soil well supplied with moisture. This is why it will be found more frequently in the bottomlands of the hill section of the State and will do better on the heavier Delta soils under average conditions. Like other crops, White Dutch does best on fertile soils but will grow well on any soil that will produce the common pasture grasses. Much of our Delta soil, because of its high silt content, poor drainage, and consequent high moisture content will grow clover and grass to advantage.

Comparative yield of clovers. Where moisture and fertility are not limited, white Dutch clover will yield hay in quantities comparable with our commonly used clovers. In an experiment conducted on Memphis silt loam at the Natchez Branch Station, all clover seeded in October at the rate of 8 pounds per acre and harvested when in full bloom, produced in the spring of 1941 the following amounts of green weight per acre:

Table 41. Yield of green weight per acre, six clover varieties.

Variety	Pounds green weight per acre
Persian	12110.1
White Dutch	22216.4
Low hop	15043.2
Red	18615.3
Crimson	24400.3
Lappa	16036.4

From these data it may be seen that white Dutch clover was outyielded by only one variety, crimson. Yields would vary much more if harvest had been made under conditions similar to those of pasturing, rather than as for hay. The continuous biting or cutting off of the leaves causes white Dutch to stool more freely than the other varieties; this is a very important pasture plant characteristic, resulting in larger total yields when measured throughout the grazing season.

Establishing white Dutch clover.* White Dutch clover should be sown after the grasses have been established. This prevents shading young grass plants, and the existing grass cover serves as a protection to the clover seedings. When sown on established grass sod, 3 to 5 pounds of seed are sufficient to give a good stand. This should be sown in the fall, by November 1. After seeding, it is well to run a spike-toothed harrow over the sod which shakes seed to the ground and the harrow tracks serve as lodging places for the small seed in case of excessive rainfall.

Table 42. Rates of seeding as affecting yield of green weight of white Dutch clover when sown alone

Rate of seeding Pounds per acre	Yield green weight per acre, 1939
2	5260.8
4	6250.8
6	9430.8
8	10367.3
10	11587.0

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 16, table 5, State College, Mississippi, July, 1941.

Hop Clover

The hop clovers are winter annual clovers with small stems which branch from the base upward. The general type of growth is similar to that of the lespedezas.

Two species of hop clover are found in Mississippi pastures, least hop (Trifolium dubium), by far the predominating, and low hop (Trifolium procumbens). Low hop grows larger and has a much larger seed head than least hop. The two look very much alike until they bloom. Low hop has yielded almost twice as much plant material per acre at the West Point Forage Crops Field as has least hop.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 16, table 5, State College, Mississippi, July, 1941.

The hop clovers are adapted to most of the soils of the State. Although they will grow on soil of a lower level of fertility than white Dutch clover, the use of phosphate will greatly increase their yield. This may be shown by results obtained from rates of phosphate application on low hop clover at the West Point field.

Establishing hop clovers.* Planting dates and methods of seeding the hop clovers are the same as those for white Dutch. Clovers sown on land that has not previously grown clover should be inoculated.

Where conditions of moisture and fertility are not favorable to the growth of white Dutch clover, or where no fertilization is to be practiced under these conditions, the hop clovers will prove to be the more dependable spring clover. However, under any system of improvement or on land of average improvement or on land of average fertility, white Dutch clover will prove to be more productive than hop clovers.

The Lespedeza Species

The annual species of lespedeza are the only summer legumes that are able to persist and furnish grazing in permanent pastures in Mississippi.

Common (Lespedeza striata) is the best of the annual species for pasture. This superiority is due to its higher per acre yield and to the fact that it is the only species that will reseed itself consistently under grazing conditions. In spite of the high cost of seed at present, this species is preferred because of its reseeding ability. However, the cost of seed will make it more economical to sow a lespedeza mixture containing only a small amount of common lespedeza and a large amount of some other species. After 2 or 3 years of grazing, common will be the only species remaining. In pastures or meadows, the necessity of reseeding other annual varieties every 2 or 3 years will in only two seedings balance the difference in seed cost between the less costly lespedeza and common. The Tennessee 76 variety of common behaves in the same manner as does common and differences are difficult to distinguish.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 18, State College, Mississippi, July, 1941.

The annual lespedezas are adapted to almost all the soil types of the State having a fair degree of fertility. Although lespedeza will respond to liming, Korean (Lespedeza stipulacea) is the only variety that is dependable on the black soils of the "Lime" or Prairie Belt, and only on this soil is Korean recommended over the other annual varieties. With the exception of this type of soil, the annual varieties show little preference for soil types of the State.

The lespedezas are very palatable and nutritious and for this reason should be included in the pasture mixture. This may be seen by the protein content of the different varieties harvested at flowering, grown on three widely varying soil types.

Establishing lespedeza.* The annual varieties of lespedeza should be planted as soon after the first of February as possible, and certainly before March 15. By early sowing, the lespedeza plants are able to make sufficient root growth to carry them through the dry periods in the spring which are so often fatal to plantings made after March 15. Losses of early plants due to cold are more than offset by the early establishment of surviving plants. Regardless of whether sown on bottom or upland soils or for what use, lespedeza should be sown early in Mississippi.

Considerable difficulty has been experienced in many sections of the state in holding lespedeza stands where fertility and moisture conditions are favorable for good growth of spring clovers, because the earlier growth of clover shades out the young lespedeza plants. Tests have shown that such growth kept 5 inches or less in height, whether by mowing or grazing, will insure lespedeza growth during the summer. Such a condition may be made advantageous in several ways. Early mowing will eradicate several species of spring weeds, and clippings can be stacked for supplemental feeding during dry periods in the summer or for winter feeding of livestock.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," pages 19 and 20, State College, Mississippi, July, 1941.

The annual varieties of lespedeza may be sown on sod without any soil preparation. It is advisable to run a spiketooth harrow over the sod after seeding. This serves as needed preparation and provides a lodging place for seed in case of excessive rains.

If use is to be made of the lespedeza crop the first year, relatively heavy seeding should be made. Sowing 25 pounds per acre will result in a hay crop or good grazing the year seeded. If a volunteer crop is desired or the pasture is to be lightly grazed, 10 to 15 pounds of seed will be sufficient to produce a good stand the second year.

Methods of Preparing Land for Carpet Grass and Lespedeza

Conducted by: South Carolina Agricultural Experiment Station, Clemson.

Conducted at: Coast Station, Summerville.

Period: 1930-33.

Purpose: To compare several methods of preparing cut-over coastal lands for carpet grass and lespedeza pastures.

Land history: The land had been cleared approximately ten years before this experiment. It was not cropped but consisted of cut-over coastal lands converted into permanent pasture.

Soil: Coxville sandy loam.

Procedure and conditions: Three plots of one acre each were set out on an area which had a complete sod of broom sedge and other native grasses of little feed value, as well as a few low bush oaks and gallberry bushes. Freshly prepared land was used each year, and each year's work constituted a separate experiment.

The three methods of preparing the land were as follows:

Plot 1. Burned in late winter.

Plot 2. Burned, disked with tractor tandem disk harrow, and harrowed with smoothing harrow.

Plot 3. Burned, plowed, disked with tractor tandem disk harrow, and harrowed with smoothing harrow.

In late March after the rains had settled the soil on plots one and two into a fairly firm seedbed, all the plots were seeded broadcast to 10 pounds of carpet grass and 5 pounds of common lespedeza per acre, after which they were harrowed with a smoothing or drag harrow. Stand counts were taken at numerous points in each plot in mid-summer.

Cattle were kept on the pastures continuously during the experiment, and the plots were closely grazed.

The seasonal condition of the pastures during the experiments was average.

Although an experiment in this series was conducted in 1930 it was merely a preliminary study. For that reason it is not included here.

Table 43. Average count of carpet grass seedlings per acre on cut-over land prepared by several methods; Summerville, S. C., 1931-33.

Carpet grass seedlings per acre	Year			
	1931	1932	1933	3-year average
Plot 1, burned	97,574	2,788	9,767	36,710
Plot 2, burned, disked and harrowed	235,866	588,931	384,622	403,140[1]
Plot 3, burned, plowed, disked and harrowed	667,688	1,113,045	500,417	760,383[1]

[1] Calculated by Southern Division A.A.A. The forty-sixth annual report gives 404,623 plants as the average for plot 2, and 760,380 plants as the average for plot 3.

Reference: United States Department of Agriculture, Agricultural Adjustment Administration Bulletin SRAC-5, "Permanent Pastures," pages 17 and 18, table 12, Washington, D. C., June, 1938.

Comparison of Bermuda and Carpet Grass for Pasture With Various Fertilizer Treatments

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1933-35.

Purpose: To determine the grazing value of established Bermuda pasture and carpet grass under three systems of fertilization.

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Land history: For the 10 years previous to 1930, pastures one and two had been used for annual grazing crops; pearl millet was planted in the spring and a mixture of oats, rye, barley, and vetch in the fall. No fertilizer or manure was applied during this period. In February 1930, both of these pastures were plowed, and clumps of Bermuda roots were scattered over the surface at intervals of about 3 feet and harrowed into the soil with a disk harrow. These pastures were used very little in 1930 because a dry season prevented the development of a good sod. In May 1931, pastures one and two each received an application of 3,000 pounds of limestone per acre. They were grazed during 1931 and 1932 before the beginning of the experimental work in 1933.

Pastures three and four were old established Bermuda grass sods which had previously been part of the regular pasture of a dairy herd. In November 1932, pasture three received an application of 3,000 pounds of limestone per acre. Pasture five had also been a part of the regular dairy pasture before being fenced in the fall of 1933. It had been seeded to carpet grass in 1925, and was, at the time of fencing and throughout the 2 years it was used for experimental grazing, a 90 to 95 percent pure stand of carpet grass.

Soil: Pastures one to four were Cecil sandy clay loam; pasture five was Wehadkee sandy loam and was located on a low-lying, poorly drained, creek bottom.

Procedure and conditions: The five areas used for these studies were designated as pastures one, two, three, four, and five. Pastures one, two, and three (Bermuda grass), were tested for the 3-year period, 1933-35. Pasture four (Bermuda grass) and pasture five (carpet grass) were tested during the 1934 and 1935 seasons. Each pasture was enclosed by a permanent fence of woven wire in order to maintain a definite net grazing area throughout the experiment.

Pasture three had been used previously by the dairy herd as a night bedding ground and in the fall of 1932 had an accumulation of manure equivalent to about five tons per acre. This was evenly distributed and was the only treatment on the area in 1933. The area was not grazed from November 1932 until the pasture season began in April 1933.

Amounts of fertilizer and dates of application for pastures one, two, three, and five are given in table 44. Pasture four was not fertilized. All limestone and fertilizers were applied as surface treatments.

In early November of 1933 and 1934, each pasture was harrowed both ways with a heavily weighted spring-tooth harrow.

Before grazing commenced each spring, wild onions were removed by digging with a light mattock. Other weeds such as dock, fennel, and certain thistles were cut by hand periodically during the growing season.

Registered Holstein, Jersey, and Guernsey cows were used in the experiments, but an attempt was made to maintain at all time a balance between Holstein and Channel Island breeds in each pasture. The pasture groups were also kept as similar as possible in age, size, and producing ability. All cows were in moderate to heavy production, at least 6 weeks advanced in lactation yet early enough in lactation to be used throughout the season. Pastures were stocked at a minimum rate of one cow per acre, and animals were added or removed as the condition of the pastures justified. When cows were added they were handled, prior to being placed on test, under the same conditions as the original cows.

Liveweight variations for the season were kept within a maximum of 10 percent of the initial weight.

Cows were milked three times per day throughout the experiment. They were weighed on three consecutive days at the beginning and end of each season, and weekly or biweekly during the balance of the period. Daily milk yields were recorded, and weekly composite milk samples were tested for butterfat.

Barn feeding was at no time discontinued entirely, although the rate varied frequently. The rate of barn feeding was regulated to maintain the milk yield at an average decline of 2.5 percent per week, using the production for the first week on pasture as a basis.

In 1933 the cows were on pasture continuously except during milking hours. In 1934 and 1935 they were kept in dry lots at night and grazed only during the day. They had access to salt, drinking water, and shade in each pasture.

Rainfall at Clemson averaged 53.33 inches over a period of 45 years. It is usually evenly distributed throughout the year except during the months of October and November. The growing period averages about 220 days. In 1935, however, only 175 days elapsed between killing frosts.

Table 44. Summary on a per acre basis of grazing tests with cattle on permanent Bermuda and on carpet grass pastures, Clemson, S. C., 1933-35.

Item	Unit	Bermuda grass				Carpet grass
		3-year average, 1933-35			2 year average 1934-35	2-yr. av. 1934-35
		Pasture 1	Pasture 2	Pasture 3	Pasture 4(check)	Pasture 5
Soil reaction and treatment:						
Average pH value 1935	pH	5.5	6.0	5.8	5.7	5.1
Limestone[1]	tons	1.5	1.5	1.5	......	......
16 percent superphosphate, annually	lbs.	308[2]	......	......	......	237.5[3]
Manure per acre, annually[4]	tons	......	......	5	......	......
Grazing data:						
Pasture area	acres	2	2	2	.97	1.38
Calendar days, continuous grazing	no.	197	197	192	186	180
Cow days[5]	do	342	310	366	226	263
Total gain or loss in liveweight	lbs.	62	74	81	52	-7
Total 4 percent milk[6]	do	11,434	9,356	11,125	7,405	7,107
Total grain fed	do	3,256	2,849	3,212	2,214	2,748
Total beet pulp fed	do	55	42	67	85	183
Total silage fed	do	539	535	563	303	636

[1] Applied to pastures 1 and 2 in May 1931, and to pasture 3 in November 1932.
[2] An average of three applications: 450 pounds in March 1933; 237.5 pounds in February 1934; and 237.5 pounds in February 1935.
[3] Applied in March 1934
[4] Applied in January 1933, 1934, and 1935.
[5] 1,000 pounds average weight.
[6] Milk converted to 4 percent basis.

Reference: United States Department of Agriculture, Agricultural Adjustment Administration Bulletin SRAC-5, "Permanent Pastures," pages 38, 39, and 40, table 25, Washington, D. C., June 1938.

PART VII

MISCELLANEOUS

Controlling Weeds and Brush

The farmers and agricultural leaders contacted in making the pasture survey shown in Part II of this bulletin all agreed that controlling weeds and other undesirable pasture plants was one of the most important and profitable pasture practices they had observed or practiced. These people likewise agreed that the mowing machine was the most effective and practical means of controlling these plants. These statements are substantiated by the fact that 72 of the 86 farmers surveyed, mowed their pastures an average of 1.8 times per year as shown in table 6 on page 22.

It is pointed out on page 41 of this bulletin that bushes were satisfactorily controlled on one of the experiment station pastures at State College, Mississippi, by mowing the pasture twice per year.

A discussion on mowing to control weeds and the value of same taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," is given below, also table from the same reference showing the production of seed by different weeds and the effect of mowing on the yield and composition of pasture material.

Mowing to Control Weeds*

Timely mowing is one of the most important pasture improvement or management practices that Mississippi farmers can follow.

This is especially true on soils of a medium or low fertility, even when seedings of desirable plants have been made and satisfactory stand obtained. The desirable plants are in competition with the undesirable plants for soil moisture and plant food. The undesirable plants, as the weeds and sedges common to Mississippi, are able to grow on soils of a lower level of fertility than are the grasses and legumes used for pasture. Usually taller in growth, they tend to shade out the desirable low-grazing plants. They are unpalatable to livestock and are thus allowed by grazing animals to grow and produce seed unhindered, while the desirable plants are grazed and their seed production is greatly reduced.

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*Taken from Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," pages 22, 23, 24, 25, 26 and 27, tables 13 and 14, State College, Mississippi, July, 1941.

Seed Produced by Common Weeds

The number of seed produced by the common weeds is surprisingly large. Averages of seed counts made on several species of weeds common to Mississippi pastures are shown in table 45. When it is realized that a single bitterweed plant may produce 3,102 seed, and a single daisy fleabane plant produced 22,785 seed—it is easy to understand why weeds unhindered "take" a pasture.

With uneven grazing or the lack of mowing permitting weeds to make these average numbers of seed per plant, pasture plants will gradually give way to the weeds.

Table 45 below shows how undesirable plants will spread if allowed to seed.

Table 45. Seed production of some pasture weeds

Plant	Heads per plant	Seed per head	Seed per plant
Bitterweed (Helenuim tenufolium)	24	130	3,120
Mayweed (Anthemis cotula)	12	169	2,028
Thistle (Circium lanceolatum)	12	863	10,356
Daisy fleabane (Erigeron philadelphicus)	93	245	22,785
Curled-leaf dock (Rumex crispus)	----	------	10,506

The value of mowing for the control of weeds is emphasized by data obtained in a mowing test conducted at the Central Station, State College, Mississippi.

Used in this test was an established permanent pasture on Houston soil. Grazing was made up principally of Dallis and Bermuda grasses, and hop and white Dutch clovers. Portions of the pasture were left unmowed for comparison with the mowed area. No other treatment was employed.

Palatability Improved by Mowing

Representative areas of both mowed and unmowed areas were protected from grazing by means of movable cages, and total yields were obtained by harvesting the growth at frequent intervals so as to duplicate as far as possible the conditions of grazing. Unprotected areas of the same size, mowed and unmowed, and representative of the growth by grazing cattle, were harvested at the same time. The difference between the yields of the protected and the unprotected areas represents the quantity of pasture growth that was eaten by grazing cattle. The 3-year average yields are reported as dry matter per acre in table 46.

Table 46. Effect of mowing on the yield and composition of pasture material

Treatment	Dry weight yield pounds	Seasonal averages	
		Percent not eaten	Percent protein
Mowed	4,052.6	20.28	11.76
Unmowed	4,386.6	50.18	6.92

Several very significant and important results are shown in this table. Most significant is the fact that the cattle left two and one-half times the amount of herbage produced on the unmowed plots as was left on the mowed plots. This was due to the presence of weeds and unpalatable plants on the unmowed areas. The tall undesirable plants—daisy fleabane and mayweed during the spring, and ragweed during the summer—growing in combination with the clovers and grasses, caused the unmowed areas to yield slightly more plant material per acre. The average difference in yield was 334 pounds of dry material or 8.2 percent in favor of the unmowed plots.

The yields of plant material do not tell the full story of pasture production, however. The one purpose of pasture forage production is that it be eaten by livestock. In this test, the cattle grazed 79.7 percent or 3,230 pounds of forage per acre on the mowed area; and the cattle grazed only 49.8 percent or 2,195 pounds of forage on the unmowed area. Thus, although slightly more forage was produced on the unmowed area, the grazing animals secured actually about 50 percent more feed from the mowed area.

Protein Increased by Mowing

Quality of production must also be considered. The lower crude protein content of the herbage produced on the unmowed areas over-balanced the slightly greater yield of plant material per acre. Producing an average of 4,386.6 pounds of dry material per acre of a 6.92 percent crude protein content means an acre production of 304.4 pounds of crude protein from the unmowed area. The mowed area had a seasonal average of 11.76 percent protein, which equals 476.6 pounds of crude protein per acre. This is a difference of 172 pounds of crude protein in favor of mowing, and the difference is equivalent to the amount contained in 422 pounds of 41 percent cottonseed meal. Timely mowing prevents the production of weed seed. By eliminating the uneven competition due to selective grazing and by consequent reduction of the weed population, improves the quality of pasture production.

Timely mowing is not just mowing, and weeds cannot be controlled by mowing after they have seeded. Mowing after seed have matured serves as reseeding rather than as control.

Time of Mowing Important

Bitterweed and mayweed should be mowed when blossoms have started forming rather than after they begin to bloom, for at this stage the seed are capable of germinating. Other annual weeds should be mowed when flowering begins. It is necessary to mow perennial weeds for 2 or 3 years, as they produce underground plant parts, by means of which they live from year to year. If these storage parts are not dug, the above-ground portion must be kept mowed until all storage material in the underground parts is used in initiating new growth.

Other than improving the quality of production by weed control, mowing improves the quality of desirable pasture plants. The crude protein content of Dallis or Bermuda grass can be increased by mowing, so that the seed stalks and fibrous growth are soon replaced by leaf growth.

The harvested material from a pure stand of Dallis grass when in the seeding stage analyzed 6.9 percent crude protein. Two weeks later the material harvested from the same area contained 18.74 percent. A pure stand of Bermuda grass handled in the same manner produced, in the seeding stage, material containing 7.1 percent crude protein while material harvested 2 weeks later was of a 19.08 percent crude protein content. In both these instances the protein content of desirable pasture grasses was more than doubled by mowing.

Controlling Fire in Pastures

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Guthrie, Oklahoma.

Period: 1932-1940.

Purpose: To determine the effect of burning grazed and ungrazed pasture on the yield of hay and also the survival of various plants.

Procedure and conditions: In 1932, 110 acres of land, lying just east of the main farm of the Red Plains Conservation Experiment Station farm at Guthrie was leased for experimental purposes. Part of this land was in native grass and scrub oak. The remainder, which had been abandoned from cultivation, was used from 1932 to 1938 for various kinds of plant cover studies. In 1939 and 1940 the whole 110 acres was used for experimental grazing.

Beginning in 1932, a fire guard 40 feet wide was burned along the property lines and roadsides each fall as soon as there was danger from unrestricted burning. In 1939 and 1940, another area which had been protected from grazing since 1930, was burned in the fall for experimental purposes. Thus, there were six different conditions available for study. A comparison of the amount of grass produced on the fire guards which were fall burned 8 years was made with that on the protected pasture under both grazed and ungrazed conditions. Another comparison of the grass on virgin land which was burned in the fall 2 years was made with that from an area that had been protected from both fire and grazing 11 years.

Composite samples of the native grass from areas of equal size on each of the six locations were collected in October 1930, and weighed. The results are given in table 47.

Table 47. Effect of annual fall burning on yield of native grass, Red Plains Conservation Experiment Station, Guthrie, Oklahoma

	Yield
Plot Treatment	Hay (pounds)
Ungrazed 8 years and unburned	2,886
Ungrazed 8 years and burned	1,366
Ungrazed 11 years and unburned	3,097
Ungrazed 11 years and unburned 2 years	1,858
Grazed 2 years and unburned	1,216
Grazed 2 years and burned 8 years	496

In a careful examination of the vegetation on the unburned as compared to the burned areas, perennial plants were found to predominate on the unburned land, while the plant cover where burning had occurred consisted largely of annuals. Apparently this condition had developed because the fire destroyed the seed of the perennial grasses and the old parent plants had died.

Reference: Oklahoma Agricultural Experiment Station Bulletin No. B-247, "The Effects of Burning Pasture and Woodland Vegetation," Stillwater, Oklahoma, pages 4 and 5, table 1, April, 1941.

PART VIII

SUPPLEMENTAL PASTURE

Year-around grazing is probably the aspiration of every livestock farmer. The average length of the grazing season on permanent pastures in Mississippi is probably about 5 to 6 months. This condition indicates that one of the critical problems confronting livestock farmers in Mississippi is to find, if possible, economical ways of extending grazing over the rest of the year. To do this will mean that grazing must be provided for the dry late summer and early fall and for winter and early spring.

Milk receipts from various milk plants in Mississippi show that milk production increases approximately 100 percent during the spring and early summer seasons. It is also recognized that most of the beef gains on pasture are made during the same seasons in Mississippi. It seems important, therefore, that farmers provide, if economically possible, green grazing during the critical periods mentioned above in order that high milk production and beef gains be continued throughout the year. Such grazing would greatly reduce the usual cost of feeding during such periods.

In recent years certain farmers in Mississippi have tried out various means of extending the grazing season on their farms. Likewise, the Mississippi Experiment Station has conducted experiments along this line. Some of the other states have done considerable experimenting with supplemental grazing crops.

The results of some of these farmer experience and experiment station tests are given on the following pages of this bulletin. These results appear in this order:

Mississippi Farmer experiences.

Experiment Station results.

Rates and dates of seeding supplemental grazing crops.

Mississippi Farmer Experiences

Northeast Mississippi Area. In this area barley and oats with crimson clover have provided excellent grazing during the fall and winter season. Of course, many other similar cases may be cited in this area. It is recommended that these crops be sown early, probably August 15 to September 15, if early fall grazing is to be secured. After the oat crop is harvested, either for grain or as a grazing crop it might be followed by Sudan grass or some other crop for supplemental summer grazing.

Rye grass, crimson clover, white Dutch clover, and Persian clover have been planted and gave good results in this area. These crops may be planted either on the permanent pasture land or on crop land, whichever is desirable. At any rate these crops afford good winter and early spring grazing and in some cases, as with white Dutch clover, grazing may be had throughout the spring and into the summer months.

Kudzu and lespedeza sericea have provided excellent grazing in this area during dry summer and fall months and are usually planted on critical slopes not suitable for cultivation or permanent pasture.

Summarizing, it seems that practically year-around succulent grazing might be obtained in this area by the use of the crops mentioned above, along with good permanent pasture, if the grazing program is properly planned in advance so that the crops might be planted at the proper time and on the soil best adapted to each plant.

Brown Loam Area. Kudzu and lespedeza sericea have provided temporary grazing during the dry summer and early fall seasons in this Area. Of course, it is recognized that it is more difficult to establish these crops than some other crops. However, they can be established on rather steep slopes and possibly badly eroded soils that might not be used otherwise economically, as well as on the better soils.

Oats and crimson clover have given good fall and winter grazing in this Area. When these crops are planted in early September or late in August, grazing has begun as early as October and continued until April 30. Crimson clover is sometimes planted alone and seems to thrive better on the higher soils in this Area, while wild winter peas can be planted on the lower or wet soils.

Some farmers follow the practice of planting lespedeza with oats; lespedeza does not afford any winter grazing but does afford grazing in the spring, summer and early fall if sufficient moisture is available. In some cases it is cut for hay.

Wild winter peas have given excellent results as a winter grazing crop in this Area. This crop affords late winter and early spring grazing, as do white Dutch clover and bur clover. These three crops may be grown either in the permanent pasture or as supplemental crops on crop land and in the latter case, they can be allowed to reseed or a crop of seed may be harvested. For seed to be produced, however, it is necessary to discontinue grazing during the seeding period. Wild winter peas are toxic to livestock during the seeding period.

South Mississippi Area. For the spring and summer grazing, kudzu and lespedeza sericea have been grown very successfully in some sections of this Area and in many cases they have been grazed temporarily; controlled grazing seems to be necessary, especially with kudzu. Kudzu has been grazed as early as May 15 and sericea as early as April 1. Alyce clover has also been grown successfully in this Area and can usually be grown on any good cotton soil; it is a warm weather plant. Lespedeza (usually common lespedeza) has also been grown successfully in South Mississippi and used as a temporary grazing crop. This crop usually grows well on practically all soils.

For fall and winter grazing, oats and vetch have been grown successfully throughout the Area; also crimson clover and wild winter peas have been grown in a few cases on the better soils and used for supplemental grazing. Rye grass has also been used as a supplemental grazing crop. Lespedeza is very commonly grown for fall grazing. It is necessary, in nearly all cases, that these fall and winter crops be reseeded annually, whereas, some of the spring and summer crops such as kudzu and sericea are perennials. Another advantage of growing such crops as kudzu and sericea is that they may be grown on critical slopes not suitable for growing other crops or permanent pasture. Also, if they are not used for grazing, they can be cut for hay which is good in quality if cut at the proper stage and properly cured. They provide excellent grazing insurance in event the summer and early fall seasons are exceptionally dry and the permanent pasture becomes short or plays out.

In many cases in South Mississippi, oats are planted and used not only as a temporary grazing crop during the winter and early spring but are harvested for grain as well. Where they are harvested for grain, grazing is usually discontinued prior to April 1.

In some cases, either rye grass, lespedeza or crimson clover are planted in combination with oats and after the oats are either harvested for grain or grazed off, the lespedeza can still be used throughout the summer and early fall as a temporary grazing crop or may be cut for hay.

Thus, in summarizing, the following supplemental crops are grown in South Mississippi, by seasons:

Spring, summer and early fall: Kudzu, lespedeza sericea, Alyce clover, and lespedeza.

Late fall, winter and early spring: Oats, vetch, ryegrass, wild winter peas, and crimson clover.

It is necessary that these crops be planted according to the need on individual farms and on the soils to which each crop is best adapted. Some of these crops are planted particularly for the purpose of conserving soil, grazing being more or less incidental. This is particularly true of kudzu and lespedeza sericea which are often planted, as mentioned above, on critical slopes and left on the land permanently.

Prairie Area. This Area is probably adapted to a wider variety of plants than most of the other soil areas in Mississippi, but variations within the area are such that they should probably be discussed in more detail as to their adaptation to soil types.

On soils of high lime content, such as Sumpter, Johnson grass and sweet clover are grown as supplemental grazing crops. With additional aids such as fertilizer application and special preparation, wild winter peas, alfalfa, and crimson clover are grown. Of course, Johnson grass and alfalfa would provide supplemental grazing in summer, while wild winter peas, crimson clover, and sweet clover would provide late winter and early spring grazing.

On terrace soils, from neutral to high lime content, Johnson grass, sweet clover, wild winter peas, Persian and Lappacia clover, vetch and Korean lespedeza are grown; and with special aid, such as fertilizer application, and special preparation, alfalfa and crimson clover are grown.

On bottom soils of high lime content, such as Catalpa, Trinity, and Leeper, Johnson grass, wild winter peas, Persian clover, crimson clover, and vetch are grown on soils having good drainage.

On soils, usually acid, such as Kaufman, Una, Oktibbeha, Eutaw, Kipling, Geiger and Crockett, crimson clover, wild winter peas, and Persian clover may be grown as supplemental grazing crops.

Thus in summarizing, it might be said that some green grazing has been provided in all the four areas mentioned above during every month in the year, even though some weeks there was very little if any grazing. Nevertheless, farmers have said that this supplemental grazing has reduced the cost of milk production and the maintenance of livestock.

In this study some observations were made as to the kind of soils on which these crops were grown. Small grains, crimson clover, bur clover, Austrian peas, and the vetches seemed to thrive best on well drained soils with medium to high fertility. Lespedeza did best on acid soils, and crimson clover was found growing on acid soils but seemed to do better on neutral and lime soils. Wild winter peas were found to thrive on extremely moist or wet soils. In fact, they did well on soils so wet that most other legumes failed to grow. White Dutch clover did best on moist fertile soils.

Grazing Johnson Grass and Wild Winter Peas

In figure 8, cows are shown grazing wild winter peas on W. A. Swoope's farm, Columbus, Mississippi.

This pasture is on Catalpa soil.

Cows were grazed intermittently from June 1 to September 30, 1942, on Johnson grass and wild winter pea residue; from November 1, 1942 to January 7, 1943, on wild winter peas; also from February 10 to March 1, 1943, on wild winter peas. No fertilizer was used on the crops.

During the three grazing periods shown above, this 84-acre pasture provided a total of 40,650 cow-days grazing or an average of 484 cow-days grazing per acre.

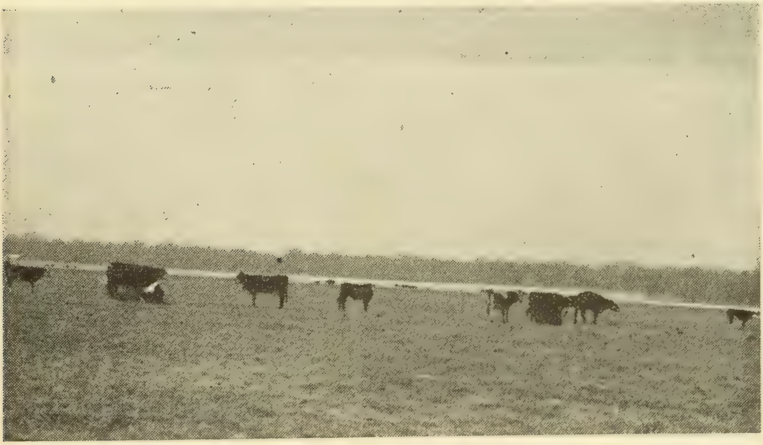

Figure 8. Wild winter pea pasture, W. A. Swoope farm, Columbus, Mississippi

Wild Winter Peas as Supplemental Pasture, Lowndes County, Mississippi

The picture below shows a part of a 45-acre pasture owned by C. H. Reeves, Columbus, Mississippi. The predominate plant shown in the picture is wild winter peas in full bloom. The picture was taken on May 14, 1942. Naturally, these peas are not as high as they would be normally due to the fact that they had been grazed heavily.

The soil types are Sumpter, Catalpa, Houston, and Hunt.

Wild winter peas were planted on a 10 to 12-year-old sod of Bermuda, Dallis and Johnson grass for the purpose of providing grazing as well as seed production.

Sixty-one head of cows were kept on the 45 acres from November 1 to March 15, 1942 and were sold on March 15 for 15 cents per pound. The principal part of the grazing during this period was from the peas. The only additional feed given was hay cut from the same field or pasture and the maximum amount fed was 8 bales per day to the entire herd. In addition, $3,300.00 worth of wild winter pea seed were harvested and sold from this field after grazing was discontinued March 15, 1942.

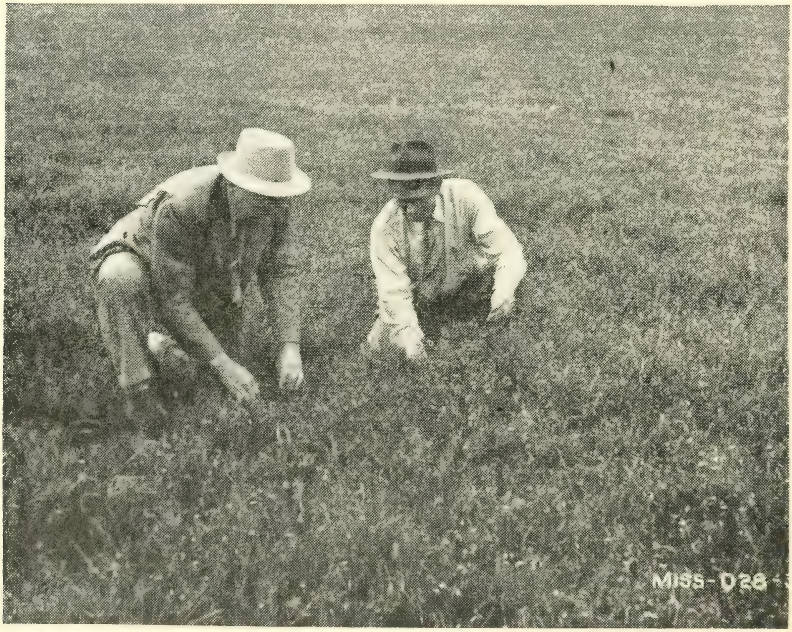

Figure 9. Wild winter pea field, C. H. Reeves' farm, Columbus, Mississippi

Grazing Lespedeza Sericea

The photograph below shows dairy cattle grazing on a field of lespedeza sericea on A. D. Kelly's farm, Mashulaville, Mississippi.

Mr. Kelly grazed 17 cows and 5 to 7 head of horses exclusively on this 11-acre field from May 1 to November 15, 1943. It is Wilcox soil, intermediate between Lufkin and Oktibbeha. The soil is in the Flatwood Area of Noxubee County and 5 years ago it was idle broom sedge land.

The season was exceptionally dry in 1943 in this area and Mr. Kelly was forced to graze his sericea field or sell the majority of his cows. He stated that his cows held up well in milk production in spite of the fact that he had to drive them over a mile each day so that they might get drinking water. He also stated that there was nothing else growing in the field except sericea and that he had no trouble getting the cattle to eat the sericea, either as a hay or pasture crop. This field usually produces about 2 tons of hay per acre and is grazed in the fall, but in 1943 it was necessary, as already mentioned, to graze the field continuously from May 1 to November 15.

No fertilizer was used on this field.

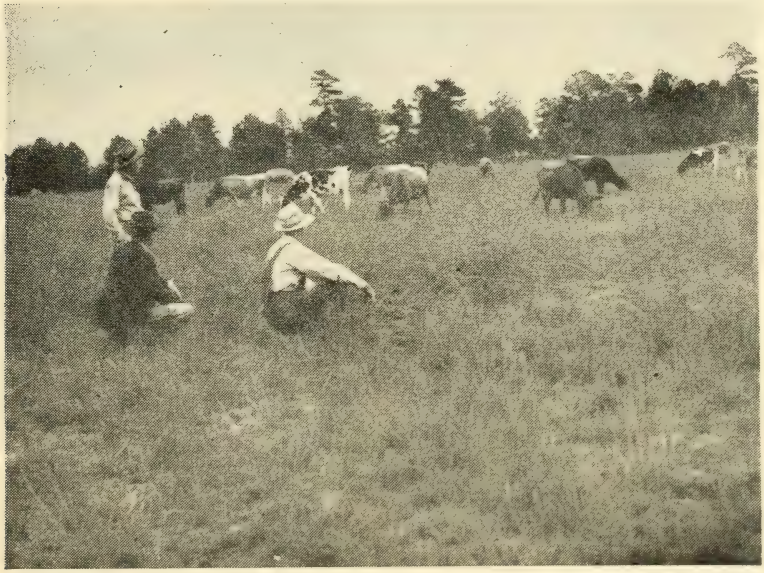

Figure 10. Lespedeza sericea field, grazed as a supplemental summer crop on A. D. Kelly's farm, Mashulaville, Mississippi

Experiment Station Results

Kudzu as a Temporary Grazing Crop

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Natchez, Mississippi.

Period: 1940-43.

Purpose: To control erosion and provide temporary grazing for livestock.

Soil: Steep, badly eroded brown loam hill land.

Procedure and conditions: A 7-acre paddock was set to kudzu in March, 1940, on badly eroded land.

In October 1942, just before frost, 1½ tons of hay per acre were harvested. In January 1943, the land was disked three times with a disk harrow which resulted in a thicker stand and a higher quality hay the following growing season. The summer of 1943, however, proved to be very dry in this section and pastures reached a dangerously low state of production. To help offset this lack of pasturage, on June 4, 31 head of cattle consisting of 23 cows, 7 calves and 1 bull were turned in on the 7-acre paddock of kudzu. No record was kept on the weight or gains of the bull.

Grazing results from this 7-acre paddock are shown in table 48.

Table 48. Grazing results on 7 acres of kudzu, 79 day test; Mississippi, 1943.

Period 1:	
Length of test, days	28
Number of cattle grazed, head	31
Average gain per head, pounds	18
Average gain per acre, pounds	77.1
Period 2:	
Length of test, days	51
Number of cattle grazed, head	6
Average gain per head, pounds	75
Average gain per acre, pounds	64.3
Periods 1 and 2:	
Average gain per acre, pounds	141.4

Reference: Mississippi Farm Research, Vol. 7, No. 6, June 1944, State College, Mississippi.

The results of tests given on the following pages were from tests conducted in other states but it is believed that they were under conditions such that the results are applicable in Mississippi.

Annual Winter Pasture For Beef Production

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: Winter 1939 and 1940.

Purpose: To compare different winter grazing crops.

Procedure and conditions: The winter temporary pasture crops were seeded as nearly as possible around October 15 following the summer annual pastures. Oats and rye were planted at the rate of 4 bushels per acre, hairy vetch 30 pounds, and ryegrass 50 pounds per acre.

Good grade yearling Hereford were used in this test. The animals were kept on and taken from the annual winter pastures as needed to make the most effective use of the crops. A mineral mixture composed of equal parts of salt, steamed bonemeal, and marble dust was kept before the cattle.

Table 49 shows the results of this test.

Reference: Georgia Coastal Plain Experiment Station Twentieth Annual Report, 1939-40, pages 44 and 45, table 29, Tifton, Georgia, July 1940.

Table 49. Grazing results from annual winter pastures; Tifton, Georgia, 1939-1940.

	PASTURE			
	Oats and hairy vetch	Abruzzi rye	Oats following common lespedeza	Rye-grass
Number of acres	6	6	6	6
Date on test	Feb. 14	Feb. 14	Feb. 14	Feb. 14
Date off test	May 3	May 3	May 3	May 3
Number animals grazed	6*	6**	6***	4****
Av. initial weight, lbs	410	393	491	484
Av. final weight, lbs	534	517	588	596
Av. gain per animal, lbs	124	124	97	112
Av. liveweight gain per acre, lbs	124	124	97	75

*Four of these animals placed on pasture April 3.
**Four of these animals removed from pasture April 4.
***Four of these animals placed on pasture April 4.
****Two of these animals placed on pasture April 3.

Pasturing Beef Cattle on Johnson Grass During the Winter Season 1939-1940, Alabama

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Marion Junction, Alabama.

Period: 1939-1940.

Purpose: (1) To determine the efficiency of matured and frosted Johnson grass when allowed to remain in the field to be grazed. (2) To determine the carrying capacity per acre of the Johnson grass when the entire production is utilized for wintering cattle.

Soil: Sumpter and Houston.

Procedure and conditions: An 80-acre field of Johnson grass was used in the trial. This field had already furnished early spring grazing on clovers followed by a cutting of Johnson grass hay in the summer. The first cutting of hay was stacked in the field, a fence put around the stacks, and the grass allowed to grow without cutting for the rest of the season. The beef breeding herd of 83 cows and 30 fall calves was turned on this field on November 15, 1939. At that time, the Johnson grass, which had been frosted, was largely headed out and ranged from waist to shoulder high. The cattle were allowed to graze the frosted grass until it was cleared up, after which the stacked hay was fed over the fence. Each cow received an average of 2.23 pounds of cottonseed meal per head daily as a supplement to the grass and hay. The results of the trial are given in table 50.

The carrying capacity period of 106 days for the 83 cows and 30 calves on 80 acres is to be compared with a required wintering period of 109 days (average for the previous 3 years). In carrying this herd for 106 days or from November 15 to March 1, the field furnished all the roughage needed.

Table 50. Wintering beef breeding herd on Johnson grass and cottonseed meal; Alabama 1938-1939.

Length of carrying period, days	106
Weight loss per cow, pounds	68.4
Gain per calf, pounds	109.0
Cottonseed meal consumed per cow, pounds	235.4

Reference: Mimeograph "The Use of Black Belt Lands In the Production of Beef Cattle," pages 4 and 5, table 2, Black Belt Substation, Marion Junction, Alabama, April 16, 1941.

Crop Program for Production of Milk On The Lime Soils of the Black Belt in Alabama

The cropping program for the 202-acre grade "A" dairy unit requires 4-3/4 acres of crops and pasture per animal. The crops and acreages are shown in the diagram.

Crops and Acreages per Animal Unit
Total acreage per cow: 4-3/4 acres

Field No. 1	Field No. 2	Field No. 3	Field No. 4
Oats followed by Johnson grass	Barley followed by Johnson grass	Wild winter peas followed by Johnson grass	Permanent pasture Black Medic White Dutch Dallis grass
1 Acre	1 Acre	1 Acre	1-3/4 Acres

Fields No. 1 and 2. In this program fields No. 1 and No. 2 are planted in oats and in barley to provide winter grazing and to produce grain for winter feeding. If preferred, field No. 2 may be planted to oats instead of barley. The best drained soils are used for small grain production. At this Substation, Sumpter soils (eroded whitish or greyish hill tops underlaid with Selma chalk) produce relatively higher yields of small grain than other soil types.

In addition to furnishing winter grazing and producing grain for winter feeding, these fields also produce Johnson grass, which comes as a volunteer crop following harvest of the small grains. The Johnson grass is used for supplementary grazing or for hay as needed.

Field No. 3. Field No. 3 is planted to wild winter peas, which are used for winter and early spring pasture. The Johnson grass following the wild winter peas is cut for hay or is used as supplementary grazing. Wild winter peas make their best growth on bottomlands that are too wet throughout the winter for small grains or other legumes.

Field No. 4. Field No. 4 is in a clover-grass permanent pasture, consisting of black medic, and white Dutch clovers, and Dallis grass. This pasture is grazed as long as it will supply nutritious green feed. When grazing on this permanent pasture is reduced because of drought or frost, fields Nos. 1, 2, and 3, are used for supplementary grazing and to supply required hay.

Fertilizer applications. Fields No. 1 and No. 2 are fertilized with 200 pounds of superphosphate or 400 pounds of basic slag per acre at grain-planting time. About March 1 the small grains are top-dressed with 100 to 200 pounds of nitrate of soda.

In the fall 400 pounds of superphosphate or 800 pounds of basic slag, and 50 to 100 pounds of muriate of potash per acre are applied to fields No. 3 and No. 4.

Reference: Leaflet, May 1944, by K. G. Baker, Supt., Black Belt Substation, Marion Junction, Alabama, "Crop Program for Production of Grade 'A' and Process Milk on the Lime Soils of the Black Belt."

The above information shows the permanent and supplemental pasture cropping and grazing program followed by the Agricultural Experiment Station, Marion Junction, Alabama.

No records are kept as to the results obtained by fields or from each crop, however, this procedure has given the most practical results over a period of years in that less feeding is necessary, especially grain feeding, than any system of management used. In fact, no roughage is fed and most of the grain fed is produced from the grains planted in this rotation or on the 4-3/4 acres allotted to each animal unit.

Comparison of Temporary Grazing Crops for Beef Steers

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1933-1938.

Purpose: To determine the effect of grazing various temporary pastures on the weight of cattle.

Procedure and conditions: Work on temporary pastures was begun at Tifton, Georgia, in 1933 and included kudzu, cattail millet, Otootan soybeans, common lespedeza and velvetbeans. Results of pasturing kudzu are available for the 6 years, 1933-38, and for the other crops for the 4 years, 1935-38. The kudzu pasture was used continuously during the summer season (from about May 1 until November 1 for the 6 years). The other crops (except lespedeza) were planted each spring. Lespedeza was scattered broadcast over the oats in the spring and thereafter came up voluntarily in the oats stubble. Cattail millet was preceded each winter by a combination of oats and hairy vetch; Otootan soybeans by Abruzzi rye or by ryegrass; common lespedeza by oats; and velvetbeans by Abruzzi rye. The summer crops, except lespedeza, were planted in rows and cultivated as much as was thought sufficient.

No fertilizers were used on any of the temporary pastures.

Steers only were used on the kudzu pasture. Good grade Hereford steers and heifers were used on the other temporary grazing crops. A mineral composed of equal parts of salt, bonemeal, and ground limestone was kept before the animals at all times. With the kudzu and lespedeza excepted, the pastures were divided into two parts and each part alternately grazed for 3 or 4 weeks. Animals were put on and taken off pastures when considered advisable.

Results of this grazing test are shown in table 51.

Table 51. Comparative effect of grazing temporary pastures on the weight of cattle, Tifton, Georgia, 1933-39, 1935-38.

	6-year average 1933-39	4-year average 1935-38			
	Kudzu	Cattail millet	Ototan soybeans	Common lespedeza	Velvetbeans[2]
Acres grazed	3	6	6	7.1	6
Acres per animal[1]	.94	.71	.74	1.1	.92
Average initial weight, lbs	497	484	504	498	598
Average gain per animal, lbs	239	80	63	106	28
Average liveweight gain per acre, lbs	247	131	108	92	39

[1] Calculated by Southern Division.
[2] 2-year average.

Reference: Mimeographed leaflet, Southern Division, A.A.A., "Experimental Data on Kudzu," pages 11 and 12.

Grazing Kudzu Continuously

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1933-40.

Purpose: To determine the value of kudzu as a crop for continuous grazing.

Soil: Norfolk and Tifton sandy loam.

Procedure and conditions: Kudzu is usually considered a temporary pasture upon which grazing is practiced heavily for short periods with intervening periods of rest for revival of growth allowed. On this test, however, the cattle were put on in the spring and grazing continued all summer. The purpose was to determine the carrying capacity and yield, and also to see if grazing could be practiced without interruption throughout the season.

Kudzu seed were planted at the rate of 1½ pounds per acre in 4-foot rows on March 12, 1931. The following May drought damaged the stand so much that transplanting with crowns had to be done the next winter. About one gallon of stable manure was placed around each plant to hasten growth and establishment. The field was cultivated the first year and part of the second year. The pasture was not well enough established to start grazing until the spring of 1933.

Later data indicate that crowns are more desirable than seed for establishing kudzu in the field because the crowns grow off faster and a more uniform stand is secured.

By the end of 1935, or 5 years after starting, the kudzu appeared to be losing vigor. During the last week in February, 1936, two tons of stable manure were broadcast per acre, and the land turned deep with a two-horse plow. The turning of the pasture covered the manure, loosened the soil, and reset the kudzu plants. The result was a good stand and renewed growth vigor in 1936. It appears necessary to follow this practice about every 5 years.

In the fall of 1934, caterpillars destroyed kudzu leaves, and the animals had to be removed on October 16, which was responsible for the low gain in liveweight per acre for that year as shown in table 52.

Table 52. Kudzu grazed continuously, upland pasture. Three acres. Fertilized with stable manure around crowns in 1932 and broadcast in 1936, Georgia, 1933-40.

	1933	1934	1935	1936	1937	1938	1939	1940	8-yr. average
Grazing started	Apr 4	May 30	Apr 3	May 6	Apr 27	Mar 22	Apr 26	May 29	
Grazing finished	Nov14*	Oct16**	Nov 5	Nov 11	Nov 2	Oct 4	Nov 1	Oct 16	
No. steers grazed	3	5	3	3	3	3	3	3	3.25
Average initial weight, lbs.	388	465	515	547	544	521	435	438	481.6
Average final weight, lbs.	646	539	862	784	782	839	667	630	718.6
Total gain liveweight, lbs.	774	372	1039	711	714	953	695	576	729.3
Av. lbs. gain per steer, lbs.	258.0	74.4	346.3	237.0	238.0	317.7	231.7	192.0	236.9
Gain in annual liveweight per acre, lbs.	258.0	124.0	346.3	237.0	238.0	317.7	231.7	192.0	243.1

*Two animals used during April, the third added April 25.
**Caterpillars damaged leaves and caused animals to be removed early.

Reference: Georgia Agricultural Experiment Station Bulletin No. 27, "Pastures for the Coastal Plain of Georgia," pages 44 and 49, table 18, Tifton, Georgia, June 1942.

Oats Followed by Common Lespedeza for Temporary Pasture

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1932-40.

Purpose: To determine the value of a combination winter and summer crop pasture in beef production.

Soil: Norfolk and Tifton sandy loam.

Procedure and conditions: The combination temporary pasture consisted of oats planted in November for late winter grazing followed by common lespedeza for summer grazing. The combination was started by planting 4 bushels of oats per acre in the fall. Oats were grazed in the spring, and about March 1 common lespedeza (20 pounds per acre) was seeded at a heavy rate in order to get earlier grazing than could be had by light seeding. Oats give best results when seeded in early October, but it has been necessary to delay plowing until about November 1 to 10 so that lespedeza seed can mature and volunteer the following spring. It is hardly possible to graze oats right on to the time lespedeza is ready because oats are grazed out about June 1 and lespedeza is not large enough to give much grazing before July 1 on upland soils where moisture is limited.

By having two crops each year on the same land the total gain per acre was 208.9 pounds over a 7-year average, or the sum of gains on both oats and lespedeza. No grazing test was conducted on oats in 1935, due to a shift of pastures. No fertilizer was used on oats or lespedeza. This test has been conducted on soil too dry for best lespedeza growth. Table 53 gives results of grazing on oats, and table 54 gives results on lespedeza.

The above practice has suggested modifications that are worth consideration where these two crops are grown for maximum yields.

In other field tests it has been definitely shown that phosphate fertilizer is decidedly beneficial to both oats and lespedeza, therefore, applications of around 300 pounds of superphosphate, or equivalent, per acre in the fall preceding the planting of oats should prove worth while. Under actual practice many farmers prefer to turn the land and plant oats about October 1, disregarding reseeding of lespedeza. This practice, although a little more expensive, allows the oats to be planted on time. The lespedeza seed, 25 to 30 pounds per acre, are sown on the young oats every spring about March 1. This insures a good crop of lespedeza which is not always had when reliance is placed on volunteer reseeding. Where this practice is followed, Kobe lespedeza can be used instead of common lespedeza, if desired.

Table 53. Oats for winter grazing, upland temporary pasture, followed by common lespedeza, 6 acres, not fertilized. (Results from lespedeza are shown in table 54).

	1933	1934	1935*	1936	1937	1938	1939	1940	7-yr. average
Grazing started	Jan 16	Feb 27		Jan 30	Feb 4	Feb 3	Jan 18	Feb 14	Feb 3
Grazing finished	Apr 25	May 29		May 19	Apr 20	May 3	May 3	May 3	May 6
No. steers grazed	3	9		7	7	4	6	6	6
Average initial weight, lbs.	459	461		370	351	398	493	491	431.8
Average final weight, lbs.	655	579		483	436	555	582	588	554.0
Total gain liveweight, lbs.	589	1061		791	595	626	536	584	683.1
Av. lbs. gain per steers, lbs.	196.3	117.9		113.0	85.0	157.0	89.3	97.3	122.2
Gain in annual liveweight per acre, lbs	98.1	176.8		105.5**	79.3**	104.0	89.3	97.3	107.2

*No winter grazing crop in 1935.
**Seven and one-half acres.

Table 54. Common lespedeza following oats, upland temporary pasture; 6 acres, not fertilized. (Results from grazing preceding crop of oats are shown in table 53).

	1932	1933	1934	1935	1936	1937	1938	1939	1940	9-yr. average
Grazing started	June 28	Apr 25	June 26	July 9	July 1	June 22	May 3	July 7	July 10	June 18
Grazing finished	Nov 14	Nov 14	Nov 14	Oct 10	Nov 3	Oct 5	Oct 3	Oct 4	Sept 28	Oct 21
No. steers grazed	3	4	6	10	7	6	4	5	4	5.4
Average initial weight, lbs.	601	435	533	400	517	494	583	529	652	527.1
Average final weight, lbs.	852	674	657	462	627	590	741	637	725	662.8
Total gain liveweight, lbs.	752	959	746	619	773	577	633	538	291	654.2
Av. lbs. gain per steer, lbs.	250.7	239.7	124.3	61.9	110.4	96.0	158.0	107.6	72.8	135.7
Gain in annual liveweight, per acre, pounds	125.3	159.8	124.3	82.5*	103.1*	76.9*	105.5	89.7	48.5	101.7

*Seven and one-half acres.

Reference: Georgia Agricultural Experiment Station Bulletin No. 27. "Pastures for the Coastal Plain of Georgia," pages 45 and 46, tables 19 and 20, Tifton, Georgia, June 1942.

Comparison of Various Winter Crops for Temporary Pastures

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1932-40 (presumably).

Purpose: To compare beef gains per acre from various winter temporary crops.

Soil: Norfolk and Tifton sandy loam.

Procedure and conditions: This test was conducted on 6-acre plots. The crops were planted broadcast but were not fertilized. The winter temporary pastures include (1) oats and hairy vetch, (2) oats-lespedeza rotation, (3) Abruzzi rye, and (4) Italian ryegrass. Winter temporary pastures are important not only in the gains per acre in beef that they furnish, but in the carrying of cattle during months when they would otherwise have to be fed from the barn.

Table 55 gives average number of steers carried on 6-acre pastures, also the average dates the animals were placed on and taken off these pastures, and the average gain in beef per acre. It will be noted that oats and hairy vetch gave an average liveweight gain of 135 pounds per acre, and that the grazing period was from February 1 to May 5, or during a time when feed is generally at premium.

Oats alone gave liveweight gain of 107 pounds per acre, Abruzzi rye 85 pounds and Italian ryegrass 50 pounds per acre.

Table 55. Grazing results on various temporary winter crops, Tifton, Georgia, 1932-40.

	Pasture crops			
	Oats and hairy vetch	Oats*	Abruzzi rye	Italian ryegrass
Period	7-yr. av.	7-yr. av.	6-yr. av.	5-yr.av.
Grazing started	Feb 1	Feb 3	Feb 4	Feb 1
Grazing finished	May 5	May 6	Apr 14	Apr 24
Av. number of steers grazed	6.0	6.0	6.0	3.8
Pounds gain in animal liveweight per acre	135	107	85	50

*7½ acres during 2 years. Oats following lespedeza in the oats-lespedeza rotation.

Reference: Georgia Coastal Plain Experiment Station Bulletin 27, "Pastures for the Coastal Plain of Georgia," page 52, table 21, Tifton, Georgia, June 1942.

Comparison of Various Summer Crops for Temporary Pastures

Conducted by: Georgia Agricultural Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1932-40.

Purpose: To compare grazing results with steers on lespedeza, Otootan soybeans, and velvetbeans.

Soil: Norfolk and Tifton sandy loam.

Procedure and conditions: Otootan soybeans, although not the highest beef producer, improved the soil for the following crops. Soybeans were an excellent temporary pasture and one reason why the beef yield was not greater was because of occasional late summer attacks by caterpillars. Thirty pounds of seed were planted per acre in 2½-foot rows.

None of the temporary pasture was fertilized. The pastures, with the exception of lespedeza which was broadcast, were planted in 2½-foot rows and cultivated two or three times and divided by a cross fence, and alternate or rotation grazing practiced. This allowed one-half of the pasture to rest and produce growth while the other was being grazed.

There were 6 acres in each plot.

Table 56. Grazing results on various temporary summer crops

	Pasture crops			
	Cattail millet	Lespedeza*	Otootan soybeans	Velvetbeans
Period	6-yr. av.	9-yr. av.	7-yr. av.	4-yr. av.
Grazing started	July 4	June 18	July 24	August 6
Grazing finished	Sept 20	Oct 21	Sept 29	Sept 27
Average number steers grazed	9.2	5.4	8.7	7.0
Gain in animal liveweight per acre, lbs	148.2	101.7	98.3	42.0

*Seven and one-half acres during 2 years. Lespedeza following oats in the oats-lespedeza rotation.

Reference: Georgia Coastal Plain Experiment Station Bulletin 27, "Pastures for the Coastal Plain of Georgia," page 53-54, table 22, Tifton, Georgia, June 1942.

Annual Summer Pasture for Beef Production

Conducted by: Georgia Coastal Plain Experiment Station.

Conducted at: Tifton, Georgia.

Period: 1935-1939.

Purpose: To compare annual summer crops for beef production.

Procedure and conditions: In this test summer and winter temporary pastures were grown in rotation on the same land, giving two crops per year. The rotation is arranged as nearly as possible where a legume follows a non-legume crop. No fertilizer was used on any of the crops. All the summer crops were planted in rows and cultivated with the exception of common lespedeza which is sown broadcast on young oats.

Good grade yearling Hereford steers and heifers were used in this test in 1939. A mineral mixture was kept before the animals at all times. The results of this 5-year test are shown in table 57.

Table 57. Annual summer pastures, Tifton, Georgia, 1935-1939.

	Pasture			
	Cattail millet	Otootan soybeans	Common lespedeza	Velvet-beans*
Av. number acres grazed	6.0	6.0	6.9	6.0
Av. number animals grazed	8.3	7.5	6.1	6.4
Av. initial weight, lbs.	492.0	510.0	504.0	611.0
Av. final weight, lbs.	583.0	579.0	610.0	645.0
Av. gain per animal, lbs.	91.0	69.0	106.0	34.0
Av. liveweight gain per acre, lbs.	141.0	102.0	92.0	41.0

*3-year average.

Reference: Georgia Coastal Plain Experiment Station Twentieth Annual Report, 1939-40, pages 43 and 44, table 28, Tifton, Georgia, July 1940.

Kudzu Versus Native Grass as Pasture Plants for Dairy Cattle

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: Summer of 1934. June 1 through remainder of pasture season.

Purpose: To determine the carrying capacity of kuduz, and the relative effects of kudzu versus native grass pasture on the production of milk and butterfat and on the color and flavor of milk.

Procedure and conditions: Four Jersey cows of as nearly uniform age and productive capacity as possible were used in the test. All cows were fed concentrates at the ration of 1 pound daily for each 2½ pounds of milk produced. Two cows were grazed on a luxuriant growth of kudzu and two cows were given the run of pasture consisting of lespedeza, Bermuda, carpet, Dallis and other native grasses. At the end of each 28-day period the cows were changed from kudzu to grass and vice versa. To determine the carrying capacity of kudzu, one cow was given the run of an acre of kudzu and another was grazed on a half acre. The effect on production is given in table 58.

Table 58. Kudzu versus native pasture in production of milk and butterfat; Auburn, Alabama, 1934.

	Pasture		
	Kudzu	Grass	In favor of kudzu
Grazing period, cow months	6	6	
Milk produced, pounds	3202.5	2775.5	427.0
Fat produced, pounds	150.98	128.65	22.33

Reference: Southern Division, A.A.A., "Experimental Data on Kudzu," page 9.

Grazing Beef Cattle on Kudzu in Alabama

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: Auburn, Alabama.

Period: 1934-35.

Purpose: To show the effect of grazing kudzu on the weight of beef cows and on the stand of kudzu.

Procedure and conditions: Four acres of established kudzu on Station Farm were divided into five plots and grazed at various rates with beef cows and heifers in the summer of 1934 and 1935.

As a means of determining the extent to which kudzu will stand grazing, the 4 acres have been grazed as one field since 1935. It was usually grazed with dry cows and 2-year-old heifers from June to August or September. The average grazing period was 68 days, and animal units per acre 1.25. The kudzu was able to survive and make a good growth. Grazing results are shown in table 59.

Table 59. Effect of grazing kudzu on the weight of beef cows, 1934-35, 2-year average.

Plot No.	Method of grazing	Acres per cow	Cow grazing days, No.	Gain (Pounds)
1[1]	Alternate	1	52	70
2	Continuous	½	29	25
3	Continuous	1	69	95
4	Continuous	1½	87	137

[1] This plot was divided into two ½-acre plots and grazed alternately.

Reference: Mimeographed leaflet, Southern Division, A.A.A., "Experimental Data on Kudzu," page 8.

Kudzu as a Grazing Crop for Hogs

Conducted by: Alabama Agricultural Experiment Station.

Conducted at: (Presumably at Auburn).

Period: 1937, June 9 to July 9, for the sow and pigs; June 9 to August 9 for the four shotes. 1938, May 11 to July 20.

Purpose: To determine the value of kudzu as a grazing crop for hogs.

Procedure and conditions: 1937: On June 9, one sow, six suckling pigs, and four shotes were placed on one acre of kudzu pasture. They were given no supplementary feed

Table 60. The effect of kudzu pasture plus some supplementary feed in 1937, and kudzu alone in 1938, on the weight of hogs, Alabama, 1937-38.

Item	1937 Kudzu pasture plus supplementary feed[1]			1938 Kudzu pasture only	
	1 sow	6 suckling pigs	4 shotes	5 pigs	3 shotes
Av. weight when turned on pasture, lbs.	215	14.3	51	25	80
Time spent on pasture, days	30	30	60	70	70
Average gain or loss per animal, lbs.	—66	+71	+.5[2]	—.4[2]	+5.66[2]

[1] Ten pounds of corn and tankage daily for 2 weeks.
[2] Calculated by Southern Division.

the first week but during the next 2 weeks received 10 pounds of grain and tankage daily. Grain feeding was then discontinued. The sow and suckling pigs were on the pasture 30 days, and the four shotes, 60 days. 1938: On May 11, five pigs and three shotes started grazing on one acre of kudzu and were on pasture 70 days. They received no supplementary feed. Results of this test are shown in table 60.

Reference: Southern Division, A.A.A., "Experimental Data on Kudzu," pages 12 and 13.

Rates and Dates of Seeding Supplemental Grazing Crops

It is generally accepted that the crops discussed in this section of the bulletin should be seeded at heavier rates when planted for supplemental grazing than when planted for grain or harvested crops. However, with high seed prices, as they are at the present time, there is a question as to what the most economical rate of seeding might be. Of course, the prices of the livestock products would be a determining factor as well as available finances for purchasing seed. Most of the experiment station tests with these crops on rates of seeding have been conducted where they were planted as crops to be harvested rather than for grazing crops.

Likewise, very little experimental data are available on dates of seeding supplemental grazing crops in Mississippi, though it is generally accepted that fall and winter grazing crops should be planted as soon as weather and moisture conditions will permit and land is available in order to get the maximum length fall and winter grazing season. General observation and experience has shown that, unless fall and winter grazing crops are planted early there is quite a period between the time summer grazing plays out in permanent pastures and the time when grazing can be had from fall and winter crops.

Considering all these factors, the Mississippi Agricultural Experiment Station makes the following general recommendations below in table 61 as to rates and dates of seeding supplemental grazing crops discussed in this bulletin.

Table 61. Recommended dates and rates of seeding supplemental pasture crops in Mississippi.

Plants	Date of seeding	Rate of seeding
Oats	By Sept. 1	4 bushels
Rye grass	By Sept. 1	25 pounds
Crimson clover	Hulled—Sept. 1 Unhulled—Aug. 15	15 pounds 40 pounds
Vetch	October 1	30 pounds
Bur clover	October 1	Hulled—10 pounds Unhulled—10 bushels
Kudzu (crowns)*	Feb. 15 to Mar. 15	In rows 6 feet each way (approximately 1000 crowns)
Lespedeza sericea	Seed one summer Graze next	35 pounds
Lespedeza	By March 1	30 pounds
Wild winter peas	October 1	40 pounds
Persian clover	October 1	10 pounds

*Date and rate of setting crowns.

APPENDIX

The Delta Area of Mississippi was not included in the special pasture study shown in this bulletin. Neither are any experimental tests shown. This is due to the fact that a small percentage of the Delta land is devoted to permanent pasture and not as much improvement and experimental work has been done as in other soil areas of Mississippi. However, Dr. H. W. Bennett, Mississippi Agricultural Experiment Station, State College, Mississippi, made a special study in 1944 of pastures in this Area, a summary of which is given below. Recommendations are also given on land preparation, seeding and pasture management.

Study of Pastures in the Mississippi Delta*

That practices in pasture making and management for the Delta will closely parallel those found essential and efficient in the hill sections, with few exceptions, was shown by an observational survey made during the past spring and summer of Delta pastures. The principal exceptions are directly related to soil fertility, and some deviations from the recommended State-wide pasture mixture will be necessary for larger yields and a longer summer grazing period.

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*Article by H. W. Bennett, Mississippi Farm Research, Vol. 7, No. 10, October 1944. Mississippi Agricultural Experiment Station, State College, Mississippi.

This survey was made by the writer through the cooperation of the District and County Agents of the Delta, interviews with planters, and A.A.A. records as to acreage, numbers and types of animals grazed, and included studies of method, time, amounts and kinds of seed sown, and mowing, fertilization, and other management practices.

Unfortunately, good permanent pastures, especially during July, August, and September, are in the minority in the Delta; but the fact that some do exist indicates that more good pastures can be developed in this section.

The survey has forcibly shown that those engaged in livestock enterprises, have made excellent progress in pasture development. It has as forcibly shown the lack of the application of some practices known to be sound and efficient, especially grazing management and timely mowing. Because of a higher level of fertility in the Delta soils, combinations of spring clovers with summer clovers and grasses were found difficult to maintain, requiring special attention to seeding and management. An urgent need for experimental work on pastures for the Delta Area was clearly shown.

The opinions, observations, and recommendations herein reported are those based entirely on the impressions and information gained by the writer from this survey and are not to be construed as a report of experimental information or data. However, most of the recommendations will be based on these spring and summer observations in conjunction with information from data obtained from pasture experiments carried on in all parts of the hill section of Mississippi.

Preparation for Delta Pastures

It was noted that many seedings, regardless of whether grass or clovers or both, were thin, and some entirely lost, because of not allowing time for the prepared seedbed to become firm. Such preparation has proven worse than no preparation at all, other than removing extremely large and dense growth of undesirable weeds or other plants.

Many areas were plowed deep with moldboard plows and then disked or harrowed until a good seedbed was prepared on the surface. In the process of this plowing, clods, grass and weeds were buried from 6 to 9 inches deep, and after the subsequent disking or harrowing or both—which perhaps completely pulverized the top 3 or 4 inches of soil—there remained a layer of clods, grass and weeds, some 3 to 4 inches thick between the pulverized surface and the plow-sole. Seed grown on such areas germinated, started to grow, but when the roots struck this "spongy" area, in seasons of small showers or light rainfall, they died. Seed sown on areas well disked and harrowed immediately afterwards, without firming with rain, suffered a like fate or else were buried by heavy rains. Areas disked, harrowed, seeded, and cultipacked is by far the better method where time is not allowed for firming.

A firm seedbed is an accepted principle in pasture establishment. It is recommended in Mississippi Experiment Station Bulletin 356 that "where soil preparation is made, it should be done far enough in advance of planting for the seedbed to become firm. All experimental evidence points to the necessity for seeding on a firm seedbed." A mixture of white Dutch, hop, and Persian clovers seeded on pastures at the Natchez Branch Station, October 1943, without any preparation was 3 to 4 inches higher the first of April 1944 than on adjoining areas that were disked and harrowed just before seeding. Recommendation: Under all types of preparation, prepare land far enough in advance of planting for the seedbed to become firmed by rain.

Seeding Mixtures

Observations, Delta wide except for the foothills, proved that some changes are necessary for the Delta from the now State-wide recommended seeding mixtures. Almost in every case, where there were spring clovers, there was little or almost no summer grazing. This indicates that winter or spring growing clovers had smothered and killed out the following lespedeza and much of the grass, except where severe periodic grazing or mowing were practiced. This is also true of fertile bottoms in the hills, or pastures heavily fertilized with minerals, and the present recommendations are to sow a spring clover without lespedeza on grass in the bottom sites and lespedeza without a spring clover on grass on the slopes.

Johnson grass appeared to be the only grass able to produce after spring clovers, which is due to the fact that this grass begins growth later in the spring than Dallis. Dallis grass begins growth with the first warm weather in the winter and spring and is therefore competing with the winter and spring growing clovers or ryegrass.

However, several Dallis grass and white Dutch pastures were furnishing good summer Dallis grass grazing, but these had been grazed heavily during the spring. This heavy grazing prevented excessive growth of clover and allowed the Dallis grass to grow in combination with the clover.

Winter ryegrass seeded on so-called permanent pastures also smothered spring and summer growing plants. There were several pastures in the Delta consisting of Dallis and Bermuda grasses and lespedeza, but no spring clover, which were furnishing excellent grazing during August and September. Also several pastures consisting only of Dallis grass and lespedeza were being grazed in those months.

Under conditions observed in the Yazoo-Mississippi Delta:

1. Because of heavy growth of spring clovers, other plants usually included in pasture mixtures to provide season-long grazing, were difficult to establish or maintain and furnished scant grazing.

2. Johnson grass withstood the clover competition most successfully.

3. Lespedeza was not successfully grown in combination with spring clover in any pasture or under any management practice observed.

4. Dallis grass and Bermuda grass were successfully grown in combination with spring clovers only where the spring clover was severely grazed or clipped.

5. Dallis grass and lespedeza as well as Bermuda and lespedeza, were successfully grown in combination in pastures where there was no ryegrass or winter clover.

These conditions are due mainly to soil fertility and moisture conditions. For pasture clover production in the hills, relatively heavy annual applications of phosphate and periodic applications of lime and potash are recommended due to the lack of fertility in the hill soils. Most of the Delta soils, however, are so fertile as to produce an excellent growth of pasture legumes without the addition of mineral fertilizers. A comparison of the range of available amounts of phosphate (P^2O^5) and potash (K^2O) in the hill and Delta soils is shown below.

	Pounds available K^2O per acre	Pounds available P^2O^5 per acre
Hills	90 - 250	20 - 200
Delta foothills	150 - 375	100 - 400
Delta proper	375 - 690	800 - 1600

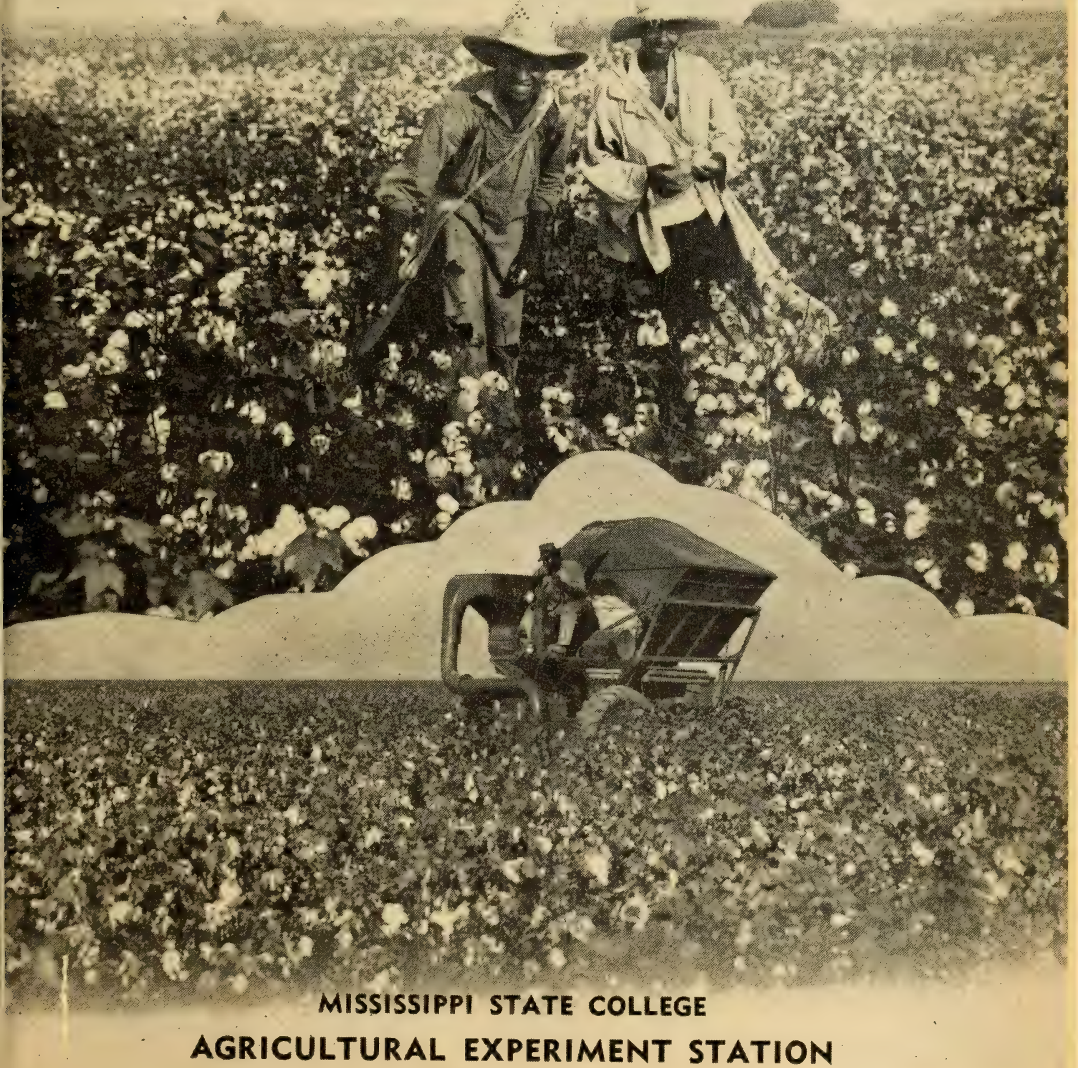
Along with this high content of minerals so beneficial to legume growth, ample rainfall is usually had during the winter and spring, and these result in a heavy growth of spring clovers and a subsequent smothering of plants that begin growth later in the spring. The summer-growing plants are often handicapped by insufficient rainfall.

Soil fertility, moisture conditions, and plant competition makes the phrase "permanent pasture" a very doubtful one for most soils of the Delta. Rather than so-called permanent pastures, this survey points to the use of "rotational pastures."

Recommendations of Seeding Mixtures

1. Use spring clovers (white Dutch, hop, Persian, wild winter peas, bur, alsike, red, crimson, on sandy well-drained soil) only as winter and spring temporary pastures. Do not sow on areas where lespedeza is wanted. Cattle should

MECHANIZATION
OF THE
COTTON HARVEST



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The authors wish to thank the following persons who contributed in various ways to the development of this study: the planters who so wholeheartedly cooperated in keeping detailed operation records and without whose assistance the study could not have been made; Dr. J. E. Adams, Superintendent of the Delta Branch Experiment Station at Stoneville, Mississippi, and members of his staff for suggestions and for appraisal of much of the data; Mr. Leo Gerdes of the United States Cotton Ginning Laboratory for assistance in checking grade loss; and Mrs. Dorothy Lee Black, Executive Manager of the Delta Council for many courtesies and general support in connection with the development of field work.

MECHANIZATION OF THE COTTON HARVEST[1]

By

FRANK J. WELCH and D. GRAY MILEY[2]

Man in his tireless search to find more efficient and effective ways of doing things has made great progress through the centuries in the fields of science, technology, and operational techniques. His material progress started with the utilization of tools; it has progressed as the quantity and quality of these tools have progressed. In the final analysis, therefore, the quantity and quality of the goods and services produced depend in large measure upon the effectiveness of man's tools and the efficiency with which these tools are used.

Technical Progress in Agriculture

The most phenomenal technological progress has perhaps been made in the broad general field of industry, but great progress has also been made in the field of agriculture. The number of workers required to produce the food supply in our own country has dropped precipitously every decade since the beginning of the 19th century. In 1840, for instance, more than three-fourths of all workers in the United States were on farms as contrasted with slightly less than one-fifth a century later.

Starting around 1850 and continuing to the present time, such patented farm implements as the chilled steel plow, power reaper, power thresher, disk harrow, haying machines, combine, twine binder, disk plow, and the modern tractor with its wide range of attachments, have all contributed materially to the increased unit output per agricultural worker and the reduction decade by decade of the relative percentage of workers on farms. See figure 1.

It should not be assumed, however, that increased efficiency in agricultural production is due solely to improved machinery and power. In addition to more power and increased numbers and efficiency of machines, production efficiency has increased significantly as a result of the introduction, adaptation, and improvement of plants and livestock; the increased ability to meet the challenge of insects, pests, and diseases; the increase in knowledge relative to the use and replenishment of soils; and finally, the improvement in managerial and marketing techniques. Continued progress may be expected in these fields as well as in the field of technology.

For whatever cause, the fact that the American farmer is able to produce the food and fiber to meet the needs of approximately five persons in addition to his own needs, accounts in large measure for the very high standard of living that now prevails in the United States. Those nations the world over that have made the greatest economic progress are those that have been able to produce their food and fiber supply with a decreasing percentage of total workers engaged in agriculture.

Cotton Production Inefficiencies and Exchange Penalties

Less progress has perhaps been made in the application of machine labor-saving devices to the production and harvesting of cotton than to any other major crop in American agriculture. Prior to World War I, about the same amount of labor was required to produce a pound of cotton as in 1860. Since then, some progress has been made in utilizing power equipment and improved machinery in seedbed preparation and in the cultivation of cotton, which has reduced the total man hour labor requirements for cotton production. The fact,

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[1] A subsequent report will deal with mechanization and other labor saving practices as they relate to the planting and cultivation of cotton.

[2] Dr. Frank J. Welch is Head, Department of Agricultural Economics, and Dr. D. Gray Miley is Associate Economist, both of the Mississippi Agricultural Experiment Station.

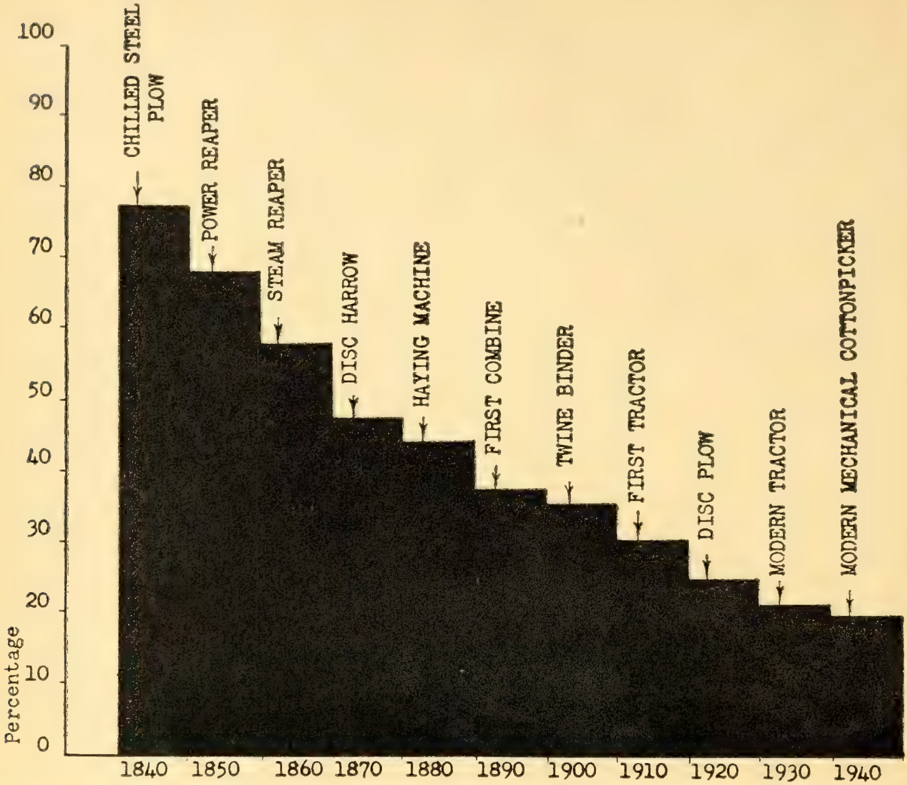

Figure 1. Percentage of the total gainfully employed workers in the United States that were engaged in agriculture in relation to the development of labor saving farm machinery, by decades, 1840-1940.

however, that a large amount of hand labor is still required to harvest the crop has hampered progress in the application of improved tools and techniques in the planting and cultivation of cotton. Consequently, much of the cotton crop is still produced with hand labor, which accounts in large measure for the low output per worker in cotton production.

The income status of the vast army of cotton field workers is adversely affected by the fact that the product of their toil is exchanged in the market place with goods much of which have been produced by skilled workers using tools that have multiplied their efficiency manyfold. A man cultivating with a hoe or working with his bare hands in the harvesting of cotton is not a competitive equal in terms of earning power with a man working with a tractor or other farm power equipment.

As a means of further complicating the American cotton producer's already unfavorable economic position, he has been forced to sell his product in the competitive world market and buy many of the products he uses and consumes on the farm in a sheltered tariff protected market at home.[3] In more recent years monopoly prices have also taken additional toll from his already meager income. In addition, credit has, generally speaking, been scarce and expensive.

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[3] Tariffs are not effective on surplus agricultural products.

Thus, production inefficiencies, high credit costs, the sale of cotton in an erratic and unstable world market, and the purchase of many of the products used in the home and on the farm in a tariff sheltered and/or otherwise partial monopoly market, explain in large measure why the cotton producers of the South receive the lowest real, as well as monetary income, of any group of workers in America. The amelioration of some of these problems is within the reach of the cotton producers themselves; whereas, other important causal factors can be dealt with only from a national or international level.

Ever since the rapid development of cotton production in the Southern colonies, there has been a reasonably adequate supply of unskilled cheap hand labor available in the Cotton Belt for the production and harvesting of the American cotton crop by simple direct hand methods. While the income to the cotton field worker, whether tenant or operating owner, has been extremely low, he has managed to eke out a tolerable existence and more than reproduce himself[4] and hope that the following year would bring about improved conditions. Even though his economic and social status has been deplored from time to time, little or nothing has been done that would induce self improvement or advance significantly the low income position of the cotton producer except temporarily as a result of wars and crop failures or other general economic dislocations.

Cotton Outlook Unfavorable

The current outlook for cotton is such that apparently something definite and tangible will have to be done in the post war period to safeguard even the present unsatisfactory economic position of the cotton producer. The ever increasing competition of producers in other countries and the phenomenal increase in synthetic and substitute products for cotton in both the domestic and foreign markets will no doubt complicate the cotton situation immeasurably.

During the period between World War

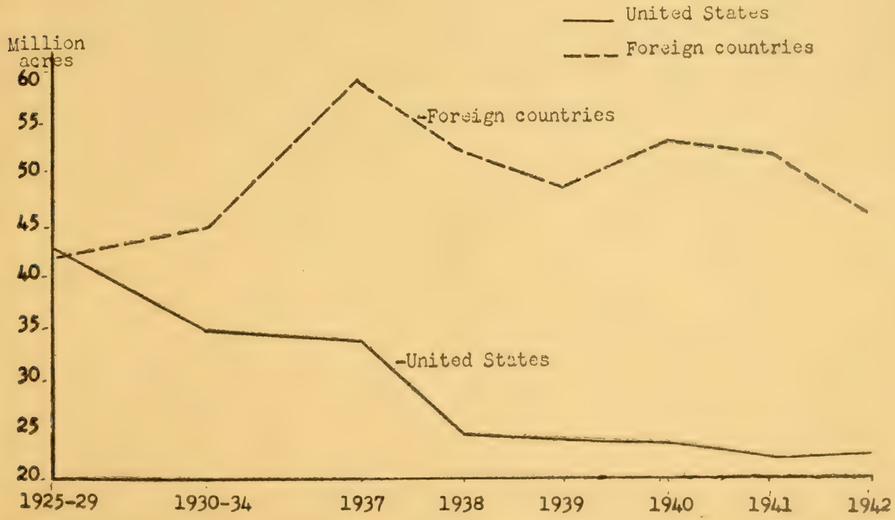

Figure 2. Cotton: Acreage in United States and all foreign countries, average for periods 1925-29, 1930-34, and by years 1937 to 1942.

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[4] The population increase in the Cotton Belt is higher than for any other major farm area in the country.

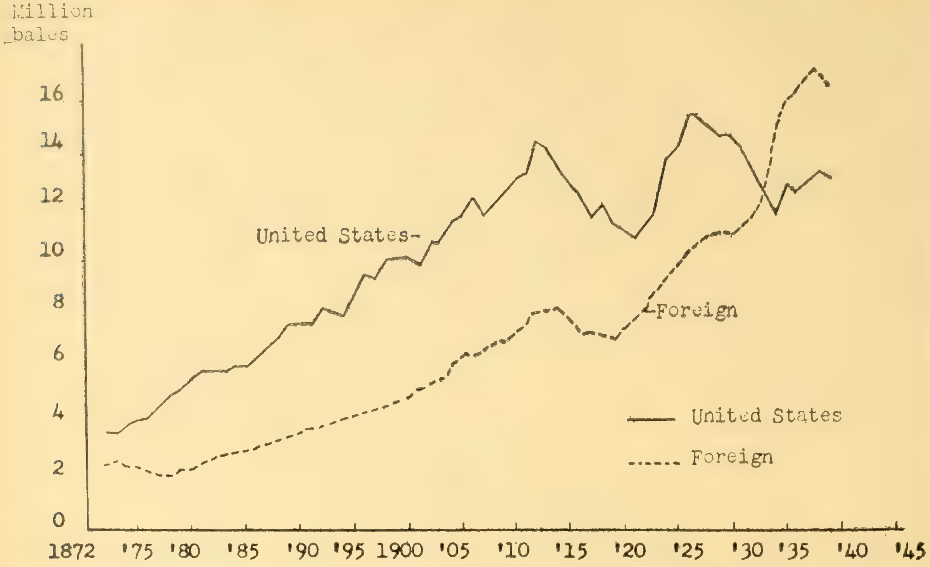

Figure 3. Cotton production in the United States and foreign countries, 5-year moving average, 1870-1940.

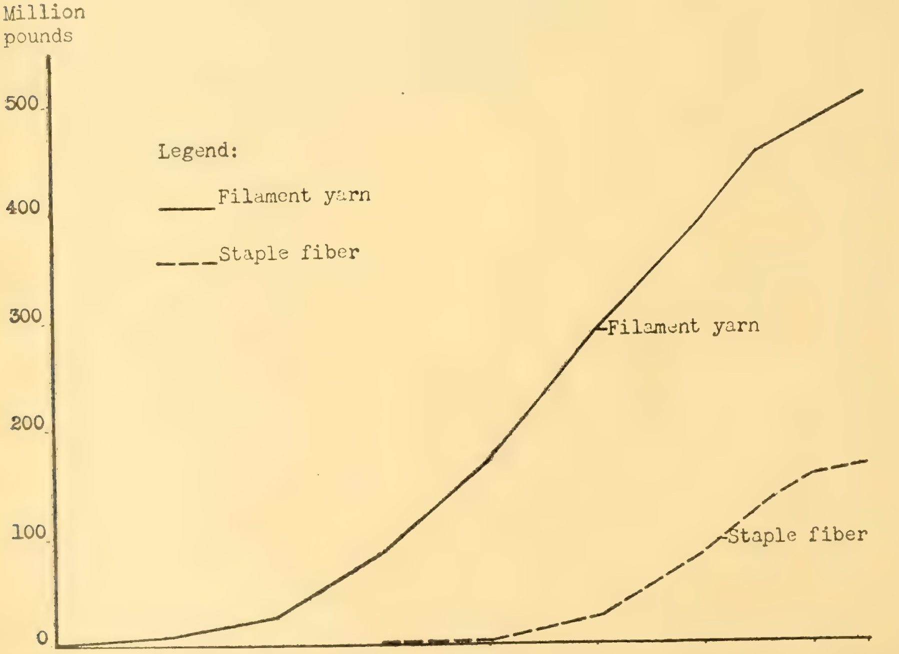

Figure 4. Production of rayon filament yarn and rayon staple fiber in the United States, by 5-year periods, 1910-1939, and by years 1940-1943.

I and World War II, the general trend of acreage planted to cotton in foreign countries was upward; whereas, cotton acreage in the United States was reduced sharply during the latter part of this same period. See figure 2. Cotton yields have been much lower in most foreign countries than in the United States, but distinct progress is being made with respect to improved yields and, as a consequence, foreign production exceeded United States production in 1934 and has been above total domestic production since that time. See figure 3.

A number of substitute and synthetic products such as paper, nylon, casein, spun glass, and rayon, have entered the market as serious competitors of cotton. The most important of these is rayon, a synthetic product made from fibrous cellulose. The production of rayon filament yarn and rayon staple fiber has been phenomenal within recent years. In 1943 there was a total of 663 million pounds of both rayon filament yarn and rayon staple fiber produced in the United States. This is equivalent to 1,560,000 bales of cotton. The world production of rayon in 1942 was 3,473 million pounds or the equivalent of 8,172,000 bales of cotton. The increased production of rayon in the United States in 1944 over 1943 was the equivalent of approximately 500,000 bales of cotton. See figure 4.

The price relationship between cotton and rayon as competitive products is extremely important. The price of rayon filament yarn decreased sharply from approximately $2.00 per pound in 1925 to about 60 cents per pound by around 1932, and has fluctuated between 52 cents and 60 cents per pound since that time. Rayon staple fiber entered the marketing field

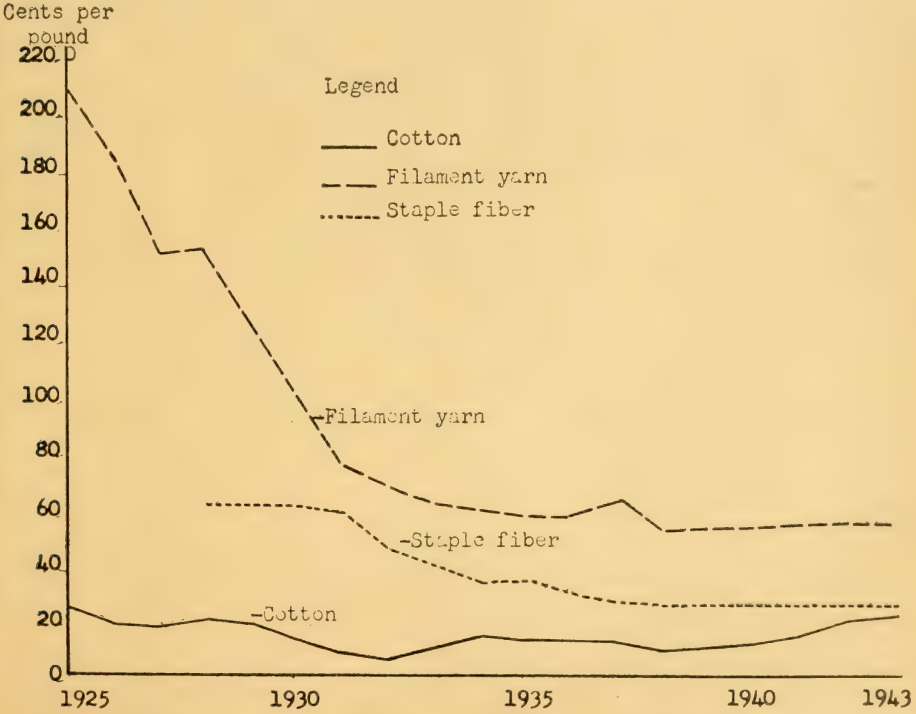

Figure 5. Average spot prices of cotton and rayon, 1925-1943.

around 1928 at 60 cents per pound and by 1938 had declined to 25 cents per pound, at which approximate level it has since remained. See figure 5.

It is predicted that the price of rayon will be still further reduced following the war. Due to losses of fiber in the processing and utilization of cotton, it must sell for approximately one-tenth less than rayon in order to be on a competitive price basis with rayon. See table 1.

Table 1. Estimated grade and manufacturing waste of cotton.

Grade	Percentage waste
Good middling	6.3
Strict middling	7.2
Middling	8.0
Strict low middling	9.2
Low middling	11.8
Strict good ordinary	14.0
Good ordinary	16.5

Source: "Cotton Fiber and Spinning Testing Service," War Food Administration, United States Department of Agriculture, September 1944, p. 10.

Reduced Production Cost Needed

Considering the low economic status of cotton producers generally, a possible reduction in the relative price of cotton means that cotton will have to be produced more cheaply, and that as a matter of equity and economic necessity the exchange penalties previously mentioned will have to be removed. Reduced cost of production can be effected through the use of better tools, more efficient practices, and through the production of better quality cotton. The improvement of the exchange status of the cotton producer will be accomplished through appropriate public policy and programs.

Cotton Harvest Labor Requirements

The amount of hand labor required to harvest an acre of cotton varies with the yield, stand, prevalence of weeds, variety of cotton, and physical characteristics of the soil on which cotton is grown. For the country as a whole, approximately 57 percent of the unweighted man hour labor requirements for the production of an acre of cotton is required for harvesting. In the Mississippi Delta Area, from 60 to 65 percent of total labor is required for harvesting, depending on the degree of mechanization; and for the irrigated areas of the West, 67 percent of total labor is for harvesting. It is thus obvious that the perfection of a mechanical cotton harvesting machine would make possible a drastic reduction in the man labor required for the production of an acre of cotton. See table 2.

Low Farm Machinery Ratio

The amount of machinery on Southern cotton farms is considerably less than that found in other farming areas of the country. Comparisons are indicated in table 3. Even though farm machinery value ratios to crop acreage and to farms are slightly higher for the Delta plantation areas than for non-plantation areas of the Cotton Belt in the Southeast, the resultant labor efficiency within the plantation area has been largely with crops other than cotton.

Increased use of power and machinery in seedbed preparation and in cultivation have resulted in somewhat higher cotton yields per acre and more efficient utilization of land and labor in these processes. So long, however, as labor must be kept on the plantation for hoeing and picking regardless of labor efficiencies in the other production processes, neither labor nor management can take full advantage of such efficiencies. They merely tend to aggravate the already rather acute underemployment problems[5].

The successful harvesting of cotton with machinery will give added impetus to mechanization and improved practices for the total production process. Such an adjustment will certainly increase very

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[5] Welch, Frank J., **The Plantation Land Tenure System in Mississippi,** Mississippi Agricultural Experiment Station Bulletin Number 385, pp. 22-23, June 1943.

Table 2. Approximate man hour labor requirements per acre for selected crops.[1]

Selected crops	Man hour labor requirements per acre
Alfalfa	20.0
All hay	4.7
Barley	9.6
Beans, snap	131.0
Corn	27.3
Cowpeas	19.0
Cabbage	109.0
Cotton[2]	133.0
Irish potatoes	68.0
Lespedeza	8.9
Oats	9.0
Peanuts	63.0
Soybeans	16.0
Sweet sorghum	14.0
Sweetpotatoes	114.0
Sorgo sirup	130.0
Tomatoes	114.0
Watermelons	59.0

[1] Adapted from **Labor Requirements for Crops and Livestock**, M. R. Cooper, W. C. Holley, H. W. Hawthorne, and R. S. Washburn, Bureau of Agricultural Economics publication, F. M. 40, 1943.

[2] Man hour labor requirements taken from Mississippi Agricultural Experiment Station Bulletin 387, "Farm Labor Requirements in Mississippi," Paul S. McComas and Frank J. Welch, 1943.

significantly the per unit labor output on cotton farms, reduce unit cost, and should, at least in the short run, tend toward an increase in cotton farm labor income.

The only remaining serious bottleneck with reference to hand labor requirements will be that of chopping and weeding the cotton. Less progress has perhaps been made to date in eliminating hand labor in thinning the cotton to a stand and eliminating the grass, weeds, and vines that cultivators will not get than in any other phase of the production process. This is the next big problem in the way of complete mechanization. However, some progress is being made through cross-cultivation and check-rowing of cotton, and experiments conducted at the Delta Branch Experiment Station indicate that the flame cultivator shows some promise as a possibility for filling this gap.[6] (Figure 7).

Cotton Harvesting Machinery

Despite the many attempts that have been made to develop a satisfactory mechanical cotton harvesting machine, most of the cotton produced today throughout the world is still harvested by the time-wasting, back-breaking methods used thousands of years ago when the Pharaohs reigned in the valley of the Nile. There has been no lack of persistent effort through the years to develop a mechanical cotton picking machine. The disappointing results of such persistent effort attest to the many difficulties associated with the problem. As early as 1850, S.

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[6] Neely, J. Winston, and Brown, Sidney G., **Control of Weeds and Grasses in Cotton by Flaming**, Mississippi Agricultural Experiment Station Circular 118, 1944.

Table 3. Farm machinery value ratios for selected areas, 1940.

Item	Value farm machinery per capita	Value farm machinery per crop acre	Value farm machinery per farm
Mississippi Delta[1]	$ 47.55	$ 7.68	$211.00
Mississippi	28.97	5.80	138.00
Southern States[2]	28.92	5.65	163.00
Midwestern States[3]	179.81	11.05	795.00
United States[4]	129.66	10.12	614.00

Source: United States Census.

[1] Includes following counties: Bolivar, Coahoma, Humphreys, Issaquena, Leflore, Quitman, Sharkey, Sunflower, Tunica, and Washington.

[2] Includes Alabama, Arkansas, Georgia, Louisiana, Mississippi, North Carolina, and South Carolina.

[3] Includes Indiana, Illinois, Iowa, Ohio, Wisconsin, and Kansas.

[4] Exclusive of 7 Southern states indicated above.

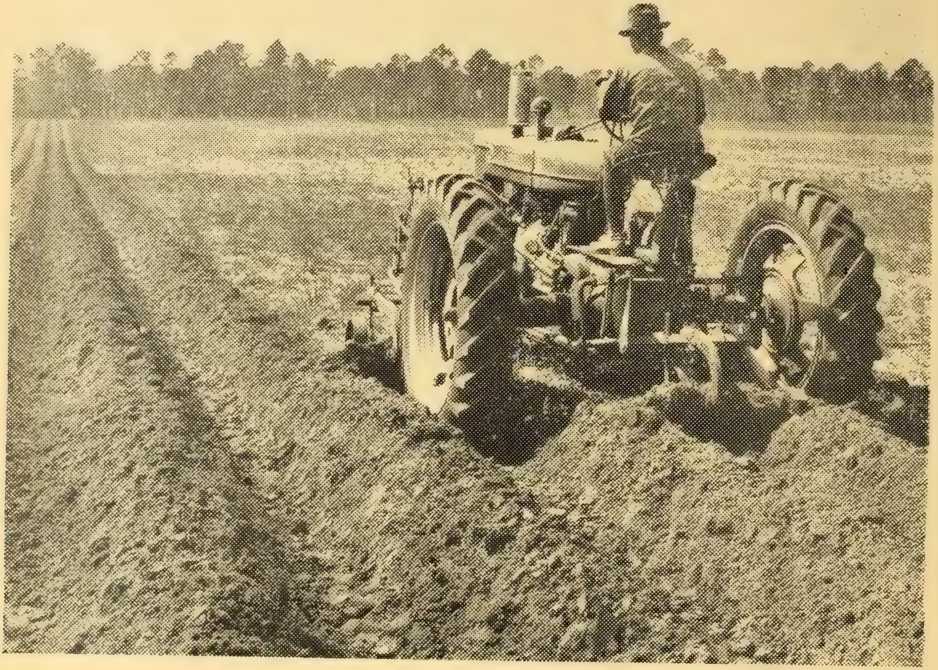

Figure 6. Preparing land (above), planting seed and cultivating cotton (on adjoining page) with three- and four-row equipment. Pictures furnished by the International Harvester Company.

S. Rembert and J. Prescott of Memphis, Tennessee, were issued a patent on a mechanical cotton picking machine. Since that time, hundreds of patents covering many kinds of mechanical cotton harvesting devices have been issued.[7]

Even though a very wide range of devices have been used experimentally in an effort to find a satisfactory cotton harvesting machine, most of the efforts can be grouped into five general classes as follows: (1) picker type, designed to pick the cotton from the open bolls by means of spindles, fingers, or prongs, (2) thresher type, which severs the stalk and takes the entire plant into the machine where the cotton and vegetative matter are separated, (3) pneumatic type, which attempts to remove the cotton from the bolls either by suction or blasts of air, (4) the electric type, designed to attract the cotton fiber to a statically charged belt to remove the cotton from the boll and, (5) the stripper type, designed to remove the cotton bolls by combing the plant with teeth or by drawing it between stationary slots or revolving rolls.

Considerable progress has been made in the development of the picker type and stripper type machines during the past decade. The stripper machine is better adapted to the sub-humid regions of Texas and Oklahoma; the picker type machine is being used in the Mississippi Delta and other relatively level cotton producing areas where the plant growth is relatively rank and the yield high.

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[7] Smith, H. P., Killough, D. T., Byrom, M. H., Scoates, D., and Jones, D. L., **The Mechanical Harvesting of Cotton,** Texas Agricultural Experiment Station Bulletin Number 452, August, 1932.

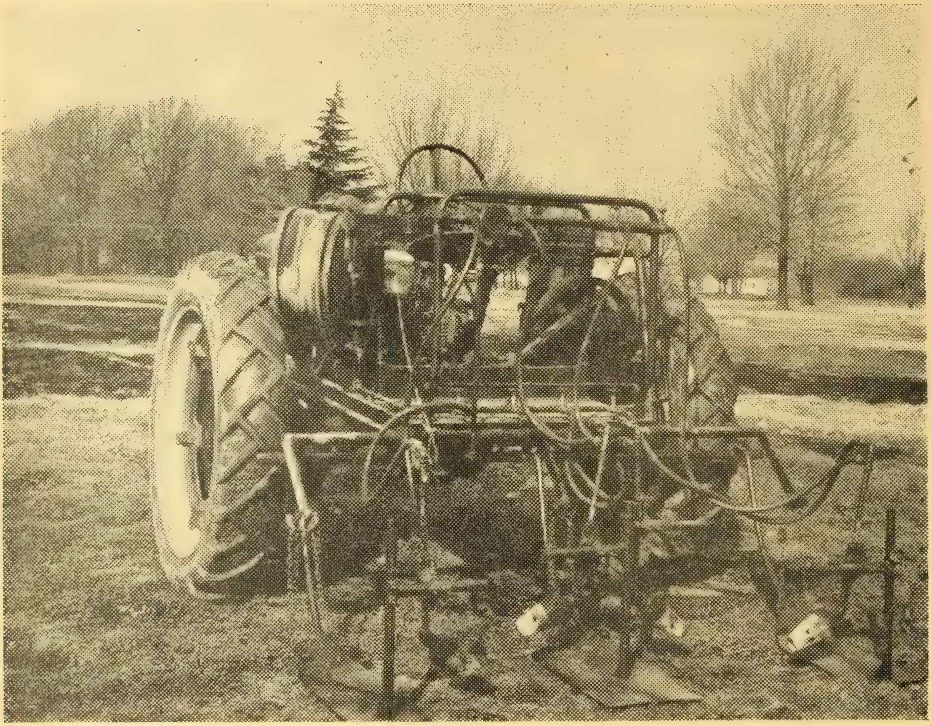

Figure 7. The flame cultivator. Picture furnished by Delta Branch Experiment Station.

Since the data for this report were obtained in Mississippi, and since the stripper has been used only to a very limited extent and largely on an experimental basis in this State, only the picker type machine will be included in this report[8]. Two general type pickers employing combinations of spindles and doffers have been developed. These two types are known as high-drum pickers and low-drum pickers. The former operate successfully in cotton growing up to 5 feet: whereas, the latter is used where the cotton stalk is 2½ feet or less in height. The low-drum machine is not adapted to Mississippi Delta conditions where the cotton plant usually grows rank.

The high-drum machine is described by the International Harvester Company as follows:

"The high-drum picker (known as No. H-10-H) is mounted on the rear of the modified Farmall-H tractor, which provides power to operate the picker and propel it through the fields. The rear of the tractor, however, becomes the front. Modifications include a high-clearance axle which provides the means of reversing the travel of the tractor from forward to rearward and lowers the gear ratios for proper picking speeds.

"The pickers are provided with two vertical and parallel revolving drums between which the cotton plants pass as the machine moves forward along the rows Each drum is equipped with cam-actuated picker bars on which are mounted rotating spindles having numerous tiny needles or barbs which catch the lint. The rotative speed of the picker drums is synchronized with the traveling speed of the tractor so that the projecting rotating picker spindles enter and withdraw from the plants without any raking action and without disturbing the unopened bolls or otherwise injuring the plants. As the rotating spindles penetrate the plants and contact the lint in the open bolls, the barbs catch the cotton and extract it. As the cam-actuated picker bars carry these cotton-laden spindles around, they are withdrawn from the plants and the cotton is removed by rubber doffers which rotate in close proximity to the spindles and thus remove the cotton. Before the spindles contact the open bolls, they pass under moistened rubber pads which moisten the spindles to assist in doffing the cotton. There is a water tank and metering system which supplies water to the rubber pads in uniform amounts controlled by the operator to give best results.

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[8] Records were kept on International Harvester machines. The Rust machine was also operated on an experimental basis within the State, but data are not available on its operation.

"After removal from the spindles the cotton is conveyed by vacuum to a separating chamber where considerable trash is removed. It is then blown up into the storage basket by air pressure produced by fan equipment. As the cotton enters the basket it passes along a grating

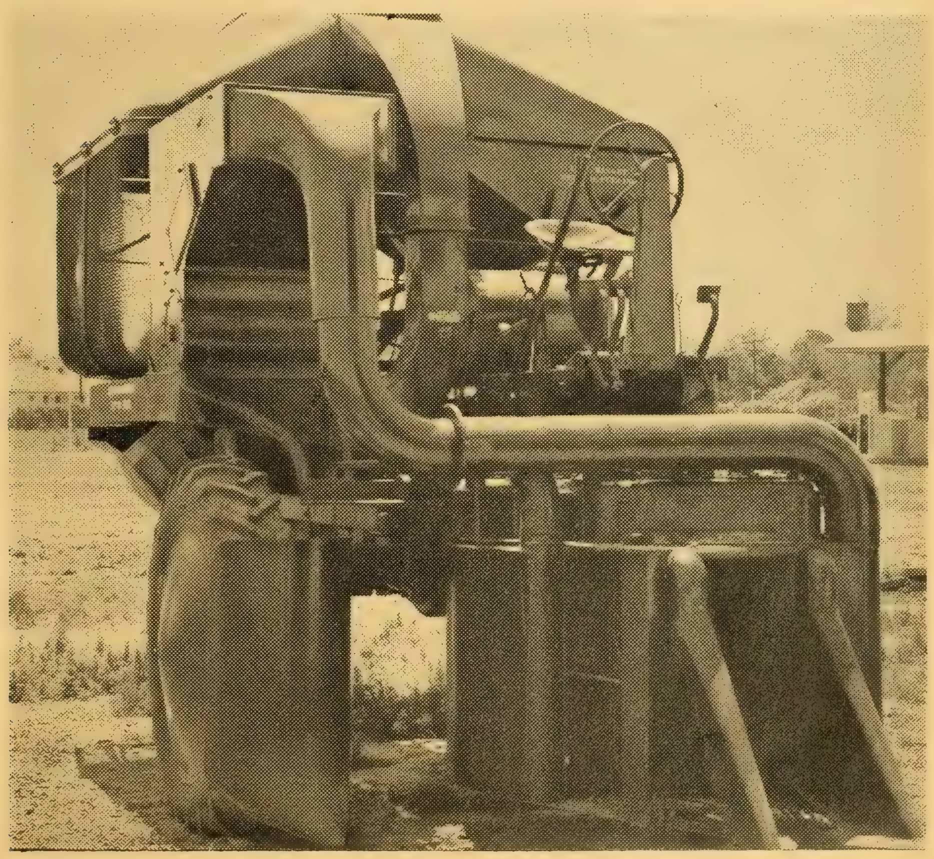

Figure 8. The International Harvester high-drum mechanical cotton picker. Picture furnished by United States Cotton Ginning Laboratory.

which further assists in removing trash. The basket holds approximately one-half bale of seed cotton. When the basket is filled, the cotton is dumped into wagon or truck by a mechanism powered by the Farmall hydraulic lift.

"The driver is the only attendant required to operate the machine. He sits comfortably above the drum box where he has a full view of the row of cotton plants being picked, which flow continuously through the drum box." See figure 8.

No doubt, considerable improvement will be made in the present cotton picking machines and the present retail price can probably be reduced when the machines are produced on assembly-line basis. Sufficient progress has been made to date, however, to demonstrate the feasibility of the mechanical harvester both from the operational and cost viewpoints, at least under current conditions of relatively high wages and scarce labor supplies.

Mechanical Operation, 1944

Detailed operational records were kept on the mechanical pickers that were used on a practical farm basis in 1944. There was a total of 12 of these machines. Records were also kept on the operation of two additional experimental machines. which data were used largely as a check against actual field data.

In addition to machine operation data, information was collected on the effect of machine on grade and the amount of cotton left by the pickers in the fields. On all of the plantations using mechanical pickers, cotton was also picked by hand. The comparative grades and prices of machine-picked cotton and hand-picked cotton were compiled for each day of harvest throughout the season in such a way as to make daily comparisons from the same plantations as well as a seasonal comparison.

Figures were also compiled by actual boll count on one plantation and by estimates on all plantations on the amount of cotton left in the field by machines. The effect on income of grade reduction and loss of cotton in the field will be indicated later.

Cost of Mechanically Picked Cotton, 1944

A total of 2,229 bales of cotton was picked during the 1944 season by the 12 machines studied, or a seasonal average of 186 bales per machine. The number of days which a machine can operate during a season, the topography of cotton fields, length of cotton rows, prevalence of weeds, and variety of cotton, are factors that influence the amount of cotton that can be picked in a day or during the season. A single machine will cover from 4 to 8 acres per day, which means. on the average for Delta conditions, from 4 to 10 bales of cotton per day can be harvested per machine.[9] During the 1944 season, the 12 machines for which records are available operated an average of 430 hours, or 43 ten-hour days. The machines actually picked an average of 4.3 bales for each 10 hours they were in operation.[10]

The average cost, not including grade loss or value of cotton left in the field, for mechanically picking a bale of cotton in 1944 was $7.38. This cost was divided as follows: direct operating cost, $3.84; depreciation, and interest cost, $3.54. See table 4 for detailed cost items.

Some of these cost figures should be regarded as tentative, especially those for maintenance and repairs. The manufac-

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[9] See **Mechanization of Delta Cotton Plantation,** by H. H. Hopson, Jr., Hopson Planting Company, Clarksdale, Mississippi.

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[10] Detailed information as to the actual acres covered by the machines is available for only one plantation. This machine operated during a part or all of 49 days and averaged operating 9.8 hours per day, a part of which was at night. A total of 228 acres was covered and 202 bales were picked. An average of 4.1 bales of cotton was picked from 4.7 acres each day the picker operated.

Table 4. Cost of operating 12 cotton pickers in the Mississippi Delta during the 1944 harvesting season.

Item	Total cost	Average per picker	Average per bale for 2,229 bales
Direct operating costs:			
Fuel	$ 1,096.79	$ 91.40	$ .492
Oil (motor and picker)	366.72	30.56	.165
Labor	3,801.13	316.76	1.705
Repairs (tractor and picker)	2,069.53	172.46	.928
Miscellaneous	1,230.69	102.56	.552
Total	$ 8,564.86	$ 713.74	$3.842
Depreciation and interest:			
Depreciation (tractor)	750.00	62.50	.336
Depreciation (pickers)	6,417.89	534.82	2.879
Interest (tractors)	75.00	6.25	.034
Interest (pickers)	641.78	53.48	.288
Total	$ 7,884.67	$ 657.05	$3.537
Total cost	$16,449.53	$1,370.79	$7.38

turers are still experimenting with the machine, consequently, some replacement parts and some repairs made by the Company were not included in the cost items. Only normal repair and upkeep charges, as nearly as these could be judged to be normal, were included in the cost items. Also, depreciation charges are rough estimates due to lack of actual experience with reference to length of life of the machines. Pickers were depreciated at the rate of 20 percent per annum "straight line," and tractors at the same rate but for only one-fourth the time since tractors are normally used for other farm work the other three-fourths of the year.

Major adjustments for tractors are necessary when pickers are attached.[11] The average cost for parts at the time of conversion was $100, which amount was added to the cost of pickers. Installation labor cost was approximately $50 and this was included with the miscellaneous items, which also included some other minor costs such as service costs for trailers used in servicing machines in the field and a few other very minor miscellaneous items.

The average cost of the pickers delivered to the plantations was $3,924, including $1,250 for the tractors on which the pickers were mounted. Thus the average cost of the pickers including conversion kit was $2,674. The interest rate on investment was calculated at 4 percent per annum on one-half the value of the pickers and one-half of the proportion of the tractor investment charged to the picking operation.

Grade Loss

Despite the excellent progress that has been made and continues to be made, both with respect to the operation of the picker and for cleaning equipment at gins, cotton picked with mechanical harvesters is given a lower grade and thus sells in the market place at a discount over that of hand-picked cotton.

The machine-picked cotton averaged 1.4 grades lower than cotton picked by hand on the same plantation on the same days for the 1944 season. The average grade for 3,506 bales of hand-picked cotton was slightly above strict low middling; whereas, the average grade for 2,229 bales of machine-picked cotton was slightly below low middling, or a difference of 1.4 grades. The range of grade differences ran from 0.8 grade on one plantation to 2.2 grades on another plantation. There was a difference of 0.2 of one staple length in favor of machine-picked cotton, which may or may not be a significant difference in fiber length. The Delta Branch Experiment Station at Stoneville reports a comparable difference from unpublished data gathered in 1944.[12]

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[11] See page 12 of this bulletin.

The average price for the grade of hand-picked cotton for the period September 1, 1944, through January 31, 1945, on the Memphis market was 21.73 cents per pound; whereas, the average price of the grade of machine-picked cotton in the same market during the same period of time was 18.05 cents per pound. The difference is equal to 3.68 cents per pound or an average of $18.40 per bale in favor of the hand-picked cotton. See table 5.

Spinning Quality

The Department of Agriculture, War Food Administration, Cotton and Fiber Branch, Stoneville, Mississippi, in preliminary tests have found that machine-picked cotton is slightly superior (stronger yarn) to that of hand-picked cotton. This is probably due to the fact that the shorter, weaker staple that constitutes the more undesirable cotton is left in the field under machine picked conditions; and when the market comes to recognize this factor, the income loss as a result of excess grade penalty will be less than it is at the present time.

Defoliation

Most of the machine-picked cotton had been defoliated by dusting the plants with calcium cyanamide dust. This cost was not added as an extra item for machine-picked cotton, since much of the hand-picked cotton was also defoliated in the same way.

By thus ridding the stalks of leaves, the bolls are exposed to the sun rays which hasten the opening of the cotton and facilitate somewhat the harvesting of cotton by both hand and machine methods.

Variety Influence

There is some indication that cotton variety may be important in terms of adaptation to mechanical harvest. Additional studies are now under way at the Delta Branch Experiment Station, Stoneville, Mississippi, and further evidence will be secured from actual field experience, but sufficient data are now lacking from which to draw any definite conclusions with reference to the importance of variety on machine harvest.

Cotton Gin Cleaning Equipment

Considerable progress has been made in the development and installation of driers and cleaning equipment on modern cotton gins. Further progress is needed, however, as evidenced by loss of grades as previously indicated. Significant progress, however, appears to have been made during the past season. A newly designed cleaner called the "impact cleaner" was installed late in the season, and the results obtained on late season, very trashy hand-picked, machine-picked, and snapped cotton were striking. Cotton that would have undoubtedly been classed as strict good ordinary was raised to as high as strict low middling as a re-

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[12] See also Mississippi Agricultural Experiment Station Service Sheet No. 364, P. W. Gull, July, 1943.

Table 5. Comparison of grades and staple lengths of machine and hand picked cotton, Mississippi Delta, 1944.

Item	Grade	Staple length	Average price (cents)	Value per bale
Machine picked	7.15	34.1	18.05	$ 90.25
Hand picked	5.75	33.9	21.73	108.65
Difference	1.4	.2	3.68	$ 18.40

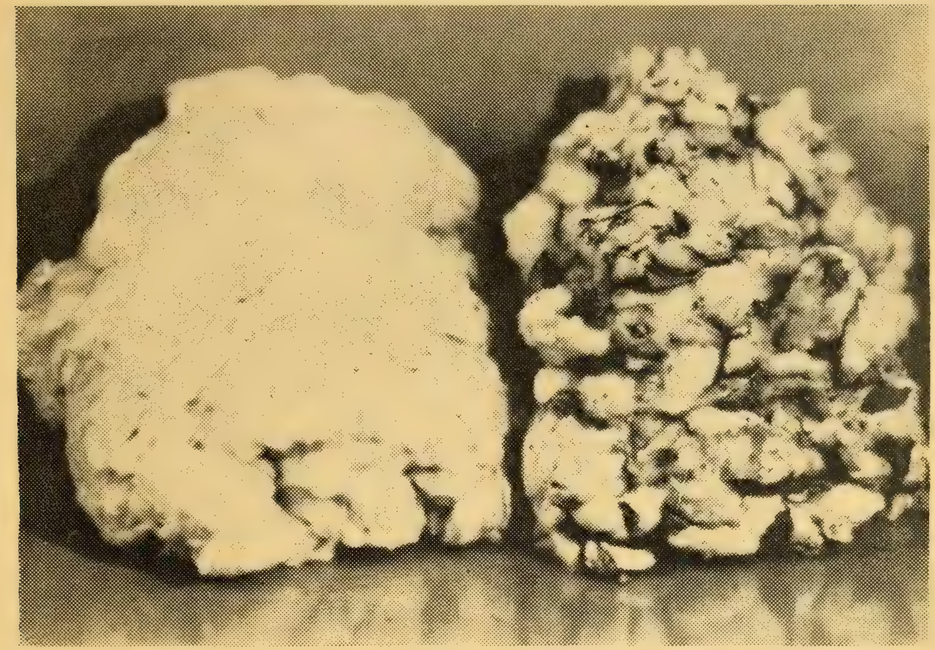

Figure 9. Comparison of very late season seed cotton (on right) that was "pulled" and the ginned lint (on left) after going through the "impact" cleaner.

sult of the usage of this cleaner. See figure 9.

There is also some question as to whether this cleaner will give the same results on early picked cotton as on late picked cotton.

The successful development of satisfactory cleaning equipment will eliminate the most significant single item of cost associated with the mechanical harvester. An approach to the solution of this problem is being made through breeding of varieties better adapted to mechanical harvesting, through establishment of cleaning equipment on pickers, and through development of better drying and cleaning equipment at the gin.

Cotton Left in Field

The amount of cotton left in the field as a result of machine operation over that which would have been left by hand picking, is a loss that needs to be considered along with the other cost items.

A detailed daily record on the basis of actual boll count was kept on one plantation throughout the season and the results showed that 91 percent of the open cotton at the time of harvest was picked by machine. Thus 9 percent of the cotton was left either on the stalks or on the ground. Estimates were made on other plantations, and it would appear, even though objective data were secured from only one plantation, that this percentage loss is about average for all the plantations studied. The losses were apparently higher in some instances and lower in others. Progress is being made in this respect through breeding and machine improvement.

Some cotton will be left in the field even when hand-picked. If we assume, therefore, that with hand labor approximately 2 percent of the cotton will be left, then there is a net loss of 7 percent of cotton due to machine operation. On the basis of current prices for hand-picked cotton and cottonseed, and after allowing for the cost of picking, this is the equivalent of about $7.62 per bale. However, from the standpoint of the producer, the loss of cotton in the field is partly offset by the additional weight of machine-picked cotton which is due to foreign matter added in the picking process. Tests show that machine-harvested cotton has about 7 percent more foreign matter than hand-picked cotton. The cotton left in the field, however, is an economic loss and should therefore be considered in any general comparisons of the two methods of harvesting cotton.

Machine vs. Hand Picking Costs

All items of operating cost and losses associated with machine-picked cotton considered, the actual direct cost of operating the picking machine is one of the smallest items involved. See table 6. Total costs and losses, including cost of picking, loss in grade, and loss of cotton left in field, was $33.40 per bale in 1944.

The cost of hand picking averaged $2.36 per hundred pounds or $37.76 per bale (1600 pounds of seed cotton) on the plantations included in this study for 1944. Comparisons at different picking rates can be readily made by the reader. See table 6.

Favorable Factors in Shift to Mechanization

Under conditions of stringent labor shortages, such as existed in 1944, there are certain advantages associated with machine operation that may not be reflected in comparative cost figures. The timeliness of harvest is an important factor, since the quality and grade of cotton usually deteriorate rather rapidly as the season advances due to weather conditions. The worry and uncertainty of getting the cotton picked under any conditions is also an important factor. See figure 10.

There are also certain other factors, not reflected in the comparative cost figures in this report, that are significant in terms of a shift to machine harvest. On the large plantations there is a heavy capital investment in living quarters and a recurring upkeep cost that is quite heavy. Moreover, seasonal labor is usually required even under the sharecropper system, the recruitment of which is bothersome and expensive under conditions of a relatively adequate labor supply. Adoption of the mechanical picker would, as has already been suggested, make feasible more complete mechanization in the whole production process and would reduce or practically eliminate the cost of maintaining a large number of tenant houses and the bother and expense of labor recruitment and labor management problems.

The relative over-all cost of mechanical harvesting versus hand picking will, of course, be the major factor in determining the rate and extent at which shifts are made to machine harvest. Such a shift, however, will involve a rather drastic reorganization of plantation operation. A careful over-all analysis, therefore, of operation under a system of machine operation compared with operation under the hand labor system will be required before all the cost factors can be considered for comparative purposes. Further studies will make such comparison possible.

Table 6. Comparative cost of machine and hand picked cotton, Mississippi Delta, 1944.

	By machine	By hand
Cost of picking	$ 7.38	$37.76
Loss in grade	18.40	—
Loss of cotton	7.62	—
Total	$33.40	$37.76

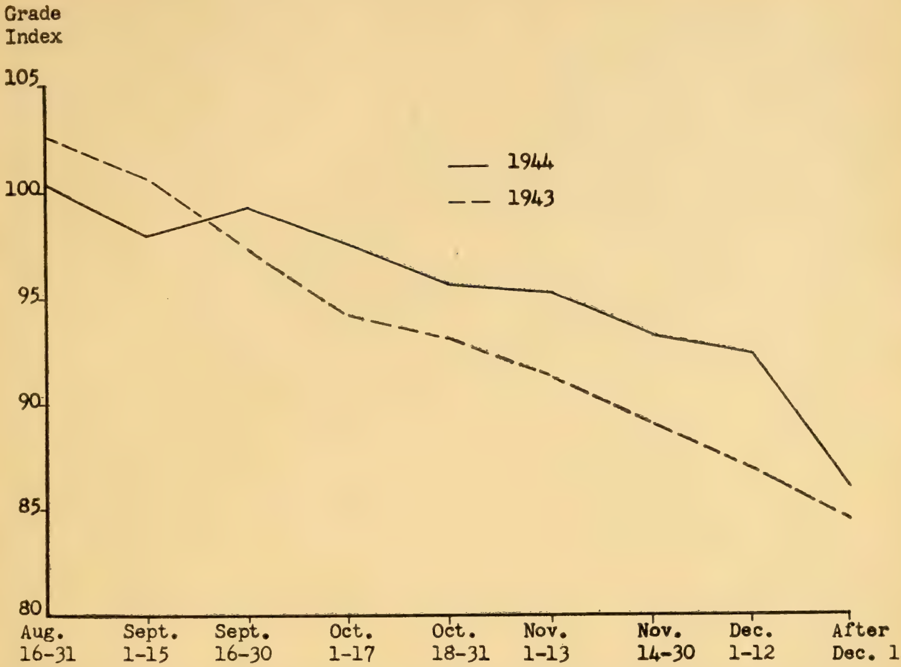

Figure 10. Grade index of cotton ginned in Mississippi by periods during the 1943 and 1944 seasons.

Retarding Factors in Shift to Mechanization

Even though there is evidence that the key to complete mechanization of the cotton industry is closer to reality today than ever before, any assumption that there will be a rapid and extensive shift to complete mechanization should be examined carefully. Had the mechanical picker been at the technological stage of development at the outbreak of the war that it is now, and had these machines been available during the war period, there can be little doubt that extensive utilization of mechanical harvesters would have resulted.

Distinct progress in mechanized cotton production will, no doubt, continue to be made in the postwar period, but the rate and extent of mechanization may be at a slower tempo than many people now anticipate. In the first place, agriculture continues to stand face to face with the problem of an increasing potential capacity to produce out of proportion to its capacity to gain outlets for its products. Secondly, some of the rural farm labor that will be displaced have had almost no experience with industrial discipline and complicated machinery, and some of them have had little experience in independent self direction as a result of the paternalistic character of the plantation system.

These special handicaps, coupled with the distinct possibility that there will be an increase generally in the number of rural persons hemmed in by limited opportunities in both city and country, may further retard the shift to complete mechanization. It should not be forgotten, furthermore, that less than a decade ago the leading newspapers in this area were advocating the junking of all mechanical cotton pickers in the Mississippi River as anti-social instruments and economically detrimental to the people within the area. Also the Agricultural Adjustment Administration was following a policy of restricting or attempting to restrict farm labor displacements. In case of rather widespread unemployment, it is quite probable that certain social and administrative restraints will again be used to discourage further farm labor displacement.

Finally, the shift to mechanical operation will all but destroy the old plantation system as it has existed since shortly after the Civil War. The large operating units under a single management will continue, but the existing paternalistic relationship between management and labor, the "furnish" system, the sharecropper pattern of operation—in short, the very heart and soul of an economic and social institutional system that has become a distinctive symbol and traditional agrarian way of life in the Cotton Belt of the South, will have passed out of existence. Vested economic interest in the operation of phases of the old system, sentiment, and the heavy hand of inertia, will delay and hinder rapid shifts even assuming favorable economies associated with such shift.

Influence of Technological Advance to Producers

The assumption that widespread shift to mechanical production of cotton will automatically solve the income problem of cotton producers seems to be rather widely accepted. Such assumption needs critical examination.

As a result of the existence of a large number of independent production units and intense competition, most of the gains in more efficient production in agriculture are, sooner or later, passed on to the consumer. Furthermore, the gains that do accrue to the producer are usually capitalized into increased land values. If improvements were adopted by producers simultaneously, consumers would undoubtedly get most of the benefits of increased efficiency quickly, but one of the most significant impacts of technological advancement in agriculture, however, is that farmers do not and cannot apply at equal rates the results of science and invention. New and old techniques continue side by side—the one-horse plow and the tractor operate in adjacent fields; one-horse wagons and modern trucks transport cotton to the same market; and very likely, the power harvester and the laborer armed only with his bare hands and a sack across his back will both continue to harvest the American cotton crop for some time to come.

As a result of uneven adoption of new machinery, scientific knowledge, and new techniques, farmers who first adopt these undoubtedly gain while others are following at an uneven pace. As more and more farmers follow in more efficient production, there is always a tendency for prices to fall or other adjustments to be made that tend to reduce or eliminate the direct economic gain to the producers. Furthermore, there is usually a significant number of farmers who, for one reason or another, cannot take advantage of the new efficient techniques, and consequently, their already low standard of living may be still further reduced as price is reduced or as they are forced to make farm adjustments that bring lower returns than did the old system under the old price level. In the long run of course, it must be assumed that those not needed on the farms as a result of production efficiencies will find alternative employment either on or off the farm.

The areas that will receive the greatest direct benefit from economies growing out of mechanization will be those areas in a position to first take advantage of the opportunity. And ultimately, of course, whatever efficiencies that may accrue will be reflected in either higher returns to producers or lower costs to consumers, or both, and the standard of living of people generally will be raised even though many individuals may find it difficult to make the necessary adjustments. In no other way can society make economic progress.

There is still another benefit that will flow from production efficiency at this particular time. And this benefit needs special emphasis. The current and prospective competitive position of American cotton is the most hazardous and precarious in its long history. Lower production costs reflected in lower selling price will strengthen the competitive position of cotton and result in a larger volume of consumption in both the domestic and foreign markets. The wide disparity between income from an acre of cotton and the next best alternative enterprise in the major cotton producing areas makes it highly desirable to maintain as large a market for American cotton as possible.

Social and Economic Effect of Mechanization

A shift to mechanization of the cotton harvest will have its effects on both the cotton plantation and the "family size" farm unit, but the repercussions will be of a different nature. Mechanization will, of course, come first in the plantation areas, which will in turn tend to force changes in farm organization and operation in the non-plantation areas. Despite certain gains that may accrue to certain producers, and despite the long-time gains to society in more efficient production and the improved competitive position of cotton, the immediate resultant economic and social dislocations and changes may be painful for both type areas unless off-farm employment is available. If so, they as well as those that remain on the farms will be benefitted.

Displacement in Plantation Areas

Complete mechanization of cotton production in the plantation areas is not expected in the near future. But assuming relatively complete mechanization of the cotton harvest together with fuller mechanization of the other production processes, this will mean a significant displacement of labor in the cotton plantation areas. Even though the population density within the plantation areas is little, if any, higher than that for the non-plantation areas of the Southeast, cotton not only plays a much more important part in the economy of the plantation area than it does in other areas, but the plantation is much better adapted to more complete mechanization. See table 7 for comparative densities for farm population.

As indicated earlier in this report, the resultant displacement of labor with mechanization will eliminate the need for plantation commissaries or stores and the plantation furnish system and in fact, destroy the established plantation system as is. This possibility emphasizes the very great need for developing alternative employment opportunities within the area either on the farms, in industry, or in other types of employment.

Under relatively complete mechanization it is difficult to forecast the probable displacement numbers, but such displace-

Table 7. Crop acres per farm person and crop acres per farm for selected areas, 1940.

Area	Crop acres[1] per farm person	Crop acres per farm
Mississippi Delta	6.19	27.49
Mississippi	5.00	23.89
Seven Southern States[2]	5.12	28.91
Six Midwestern States[3]	16.27	71.93
United States[4]	12.81	60.71

[1] Acres harvested in 1939.

[2] The states of North Carolina, South Carolina, Georgia, Alabama, Mississippi, Arkansas, and Louisiana.

[3] The states of Ohio, Indiana, Illinois, Wisconsin, Iowa, and Kansas.

[4] Excluding 7 states above.

ment obviously will be high. The labor required to produce an acre of cotton using a mechanical picker is only 37 percent of the labor required to produce an acre of cotton using hand labor for harvesting, the equivalent of a 63 percent reduction in total man hour requirements. This percentage change assumes the usage of multiple-row planters and cultivators, but even with multiple-row equipment, already in use, there is little doubt that still further reductions will be made in man hour requirements in planting and cultivating when mechanical pickers can be introduced. Thus a conservative estimate of labor displacement runs from 55 to 65 percent.

A few plantations are already operating on a ratio of about one family for each 100 acres of cropland by utilizing seasonal labor for chopping and picking. In 1940 there was one family for each 27 acres of cropland in the Delta area. On the assumption that widespread adoption of the picker would make possible adjustment of the labor force to 100 acres of cropland for each family instead of 27 acres per family as in 1940, then 73 percent of the present families would not be needed.

In 1940 there were 64,683 farm families, or a total farm population of 287,111 in the 10 all-Delta counties. A 73 percent reduction would mean that these counties alone would lose 47,218 families and 209,591 in rural-farm population. But, as a matter of fact, the area has probably already lost from 30 to 35 percent to the Selective Service and to war industries since 1940. If postwar conditions are such that few agricultural workers return to the area, then obviously the effect of mechanization will be correspondingly less severe.

Even though society will gain little or nothing in the short run from technological advancement in agriculture if displaced labor go to swell the relief rolls or are forced to find employment on made-work projects, such a contingency does not justify the discouragement of more efficient techniques of production. To do so would hamper or prevent economic progress and the gradual improvement in standards of living for everyone. However, inasmuch as society benefits from such progress in the long run, society should contribute to cushioning the shock of technological unemployment and general economic and social dislocations that result from such progress.

Adjustments in Non-Plantation Areas

Relatively complete mechanization of the cotton harvest (and in turn, cotton production) will have its effect on the non-plantation areas of the Cotton Belt even though the adjustments will be somewhat of a different nature. The ratio of farm population to cropland indicates a relative dependence on intensive crop production equal to that in the plantation areas. See table 7.

The non-plantation areas of the Southern cotton states are characterized by small operating units. Despite the fact that most of these units have only a small acreage of cotton, cotton and cottonseed products constitute the major cash income crop, and in fact, there is no alternative crop outside the concentrated tobacco, peanut, and a few high specialty crop areas that will provide acreage or labor returns anywhere nearly equal to that of cotton.

The vast majority of these farms are too small to shift to mechanized operation; the topography of many others hinders or precludes shift to mechanized operation; many of them, equipped as they are now with little farm machinery and equipment, provide even less under these conditions than full employment the year round; and finally, the landscape is characterized by extensive erosion and poor management practices. The availability, therefore, of effective cotton picking machines and other mechanized equipment provides little or no opportunity for improved practices and increased income in the absence of drastic reorganization and enlargement of operating units.

The contention that these small "upland" operators can take advantage of mechanized operation either through cooperative purchase or custom service overlooks the fact that such an arrangement guarantees neither increased production nor cheaper production. As a matter of fact, if mechanized operation merely displaces hand labor without providing alternative employment opportunities, cash costs may move up without corresponding increase in income. With income already normally near the subsistence level, any such adjustment might be intolerable. In other words, any labor income on these small units—whether from women and children or whatever it might be—that would otherwise run to waste, is just that much additional income. The cotton picker would cut down sharply on practically the only source of employment for women and children on these small farms, which is desirable from both a social and economic viewpoint, provided of course some other means of maintaining or increasing the present income can be found.

With the coming of mechanized cotton production and its concomitant economies in the areas adapted to mechanized operation, the areas of small cotton farm operation, under the impact of assumed lower cotton prices, may be forced to shift more to livestock and other crops. Such an adjustment will mean a more extensive type of agriculture, which in turn means that operating units will have to be enlarged and more machinery, equipment, buildings, and other operating facilities provided. This will involve a very considerable reduction in farm population within these areas, change in ownership patterns, additional credit, and significant adjustments in the whole range of service institutions. There is no reason to believe that these adjustments will be any less painful or disturbing than those taking place in the plantation areas.

General Summary and Conclusions

There is evidence that the key to the successful mechanical harvesting of cotton and in turn the complete mechanization of cotton production, is closer to reality today than ever before. Actual farm experience with a sufficient number of machines during the past two or three seasons in the Yazoo-Mississippi Delta has demonstrated the technical and economic feasibility of harvesting cotton with machinery. With the advent of a successful cotton picking machine, the only serious bottleneck to complete mechanization of cotton production will be that of properly thinning and weeding the cotton.

The average cost per bale of machine-harvest of 2,229 bales of cotton by 12 machines during the 1944 season was as follows: direct operating cost, $3.84; depreciation and interest cost, $3.54; grade loss as a result of mechanical harvest, $18.40; value of cotton left in field that would have been picked by hand labor, $7.62; totals, $33.40.

The cost of hand picking a bale of cotton on the plantations using machines at prevailing wages in 1944 was $2.36 per hundred pounds, or $37.76 per bale, with 1600 pounds seed cotton per bale.

The rate and extent of shift to mechanical harvest in the immediate future will depend upon a number of unpredictable influences such as the following: supply and cost of hand labor; alternative employment opportunities for displaced farm labor; realization of anticipated progress in technical improvement of picking machine and of cleaning devices at the gin, and in the breeding of varieties better adapted to mechanical harvest; and finally, the discovery of ways and means of utilizing machines for harvesting cotton in the rolling upland, small farm, small field areas of the Southeast.

The assumption that widespread shift to mechanical production of cotton will automatically solve the income and market outlet problems of cotton producers merits critical appraisal. Past experience has demonstrated that production efficiency gains are, for the most part, sooner or later passed on to consumers, or that whatever gains do accrue to producers are capitalized into increased land values. Society would, however, gain as a result of any efficiencies associated with shift to mechanization, and the competitive position of cotton as well as the cotton producer would be distinctly improved.

A shift to mechanization of the cotton harvest will leave its impact on both the cotton plantation and the "family size" farm unit. Relatively complete shift to mechanized operation will mean a heavy displacement of labor in both types of areas. The traditional plantation system as such will undergo significant changes. The whole institutional arrangement within the plantation areas will be subject to drastic change and the farm population may shrink some 60 to 75 percent.

In the small or "family size" farm areas of the Cotton Belt where the pressure of farm population against land resources is equal to or greater than in the plantation areas, adjustments looking towards a more extensive agriculture and a displacement of farm population only slightly less than in the plantation areas may take place. Such adjustments would mean the enlargement of operating units with more machinery, equipment, buildings, and other operating facilities and a greater amount of capital investment. In the absence of other employment opportunities either on the farms with some other intensive enterprise or combination of enterprises or off the farms within the areas, the whole range of institutional service patterns may undergo significant change within these areas.

American cotton production must be made more efficient if it is to compete successfully in the market place with foreign grown cotton and synthetic and substitute products and at the same time bring the producer anything like an adequate income. The economic and social dislocations and adjustments as well as the ultimate benefits that rather complete mechanization of cotton production and harvesting will inevitably bring, must be shared by society as a whole.

BULLETIN 421 (Revision of Bulletin 403) JULY 1945

The Economics
OF
COTTON GIN OPERATION

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MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, *Director*

STATE COLLEGE MISSISSIPPI

This bulletin is a revision of bulletin number 403 which was issued in June 1944. The study reported in the previous issue has been continued for the second year in the same area and expanded to include the gins located in four counties in Northern Mississippi. The research was conducted jointly by the Agricultural Economics Department of the Mississippi Experiment Station and the Research and Testing Division, Cotton and Fiber Branch, Office of Marketing Services, Washington, D. C.

The authors are grateful to Mr. F. L. Gerdes, Dr. John W. Wright and Dr. Frank J. Welch for helpful counsel in the developments throughout the conduct of the project. Especial credit is due Mr. W. H. Fortenberry of the United States Cotton Ginning Laboratory for work done in appraising and evaluating the gin machinery and equipment. The help given by the district agents and the county agents in the areas studied was very valuable and is appreciated. Of course this study would not have been possible without the records made available by the ginners in the sample counties. The kindness and patience displayed by these men made the conduct of this study a pleasure.

Appreciation is extended to the General Education Board for grant of funds that made it possible for the Agricultural Economics Department of the Mississippi Experiment Station to participate in this study.

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Summary 31

The Economics of Cotton Gin Operation

BY

D. GRAY MILEY AND ARTHUR L. ROBERTS[1]

Inasmuch as cotton is a raw product of the textile and other industries it has to compete at the point of entry into these industries with all other products that can be substituted for cotton. That is, the focal point of the serious competition facing cotton is the price of cotton as a raw product compared with the price of other products both natural and synthetic that can be readily substituted for cotton. So long as these competing products can be substituted for cotton on fairly equal terms the price of cotton laid down at the manufacturer's door will be the major determining factor in the competitive process. If the textile, tire or other manufacturer can buy rayon and make it into products that the consuming public will buy in such quantities as to net him more profit than he can make from cotton goods, he is very likely to use rayon as a raw product.

In this competitive process the product that is of the highest quality and sells for the lowest price will be in greatest demand. The cotton gin plays a very important part in preparing good quality cotton for the market. The modern cotton gin does not eliminate the need for careful picking and handling of the seed cotton, but when properly operated it can take carefully picked cotton and turn out an attractive bale of lint. Neither can the gin put into the fibers any length and quality that is not already there. The modern gin can preserve the length and quality that is there and remove the major part of the grade lowering content of foreign matter. With driers and the latest cleaning equipment cotton that is delivered to the gin in reasonably good condition will turn out a good sample.

For several years the average staple length of cotton produced in Mississippi has been increasing in the hill areas of the State and decreasing in the Delta area. The entire State is tending toward the production of the medium staple cottons that range from an inch to an inch and three thirty-seconds in length. For the hill areas, this means the production of cottons that are of a higher quality from the standpoint of staple length than the short cottons formerly produced.

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[1] Miley, D. Gray, Agricultural Economist, Mississippi Experiment Station; Roberts, Arthur L., Agricultural Economist, Research and Testing Division, Cotton and Fiber Branch, Office of Distribution, Washington, D. C.

However, along with this increase in staple length has come a constant decline in average grades. This decline has been such that the increased value that should have come with the increased staple length has been almost completely offset by the decline in grade, and the monetary return to the producer has not increased as much as was expected.

It is a known fact that the short staple cottons can be ginned more readily and a satisfactory sample can be secured with less care and equipment than is the case with the longer cottons. With the short cottons the foreign matter, which is one of the main grade lowering factors, sifts out quite readily in the ginning process and a good sample is secured without the use of elaborate cleaning equipment. With the longer cottons, however, the trash, leaves and other foreign matter is much harder to remove.

One of the major assumptions of this study was that modern well equipped cotton gins would give a better grade of ginned cotton with all staple lengths but more especially with the longer cottons, than those gins that were not so well equipped. A companion assumption was that the lack of proper cleaning, drying, and ginning equipment was partly responsible for the lower grades obtained with the longer cottons that are being grown.

METHOD OF STUDY

This is the second year in which the operations of cotton gins in four counties in central Mississippi have been studied rather intensively.[2] In addition to this same group of gins, information was obtained for the gins that operated in Marshall, Benton, Tippah, and Alcorn Counties. Detailed appraisals were made of each gin during the ginning season and were used as a basis for dividing the gins into groups according to their mechanical ability to perform an efficient job of ginning as well as for the purpose of charging depreciation and interest in the cost calculations. In addition to this information, detailed cost records were obtained by personal contact with the ginners at the close of the 1944 ginning season. The grades of cotton ginned on each gin were obtained from the Cotton Classing Officer of the Office of Marketing Services, WFA, at Jackson, Mississippi, and Memphis, Tennessee.

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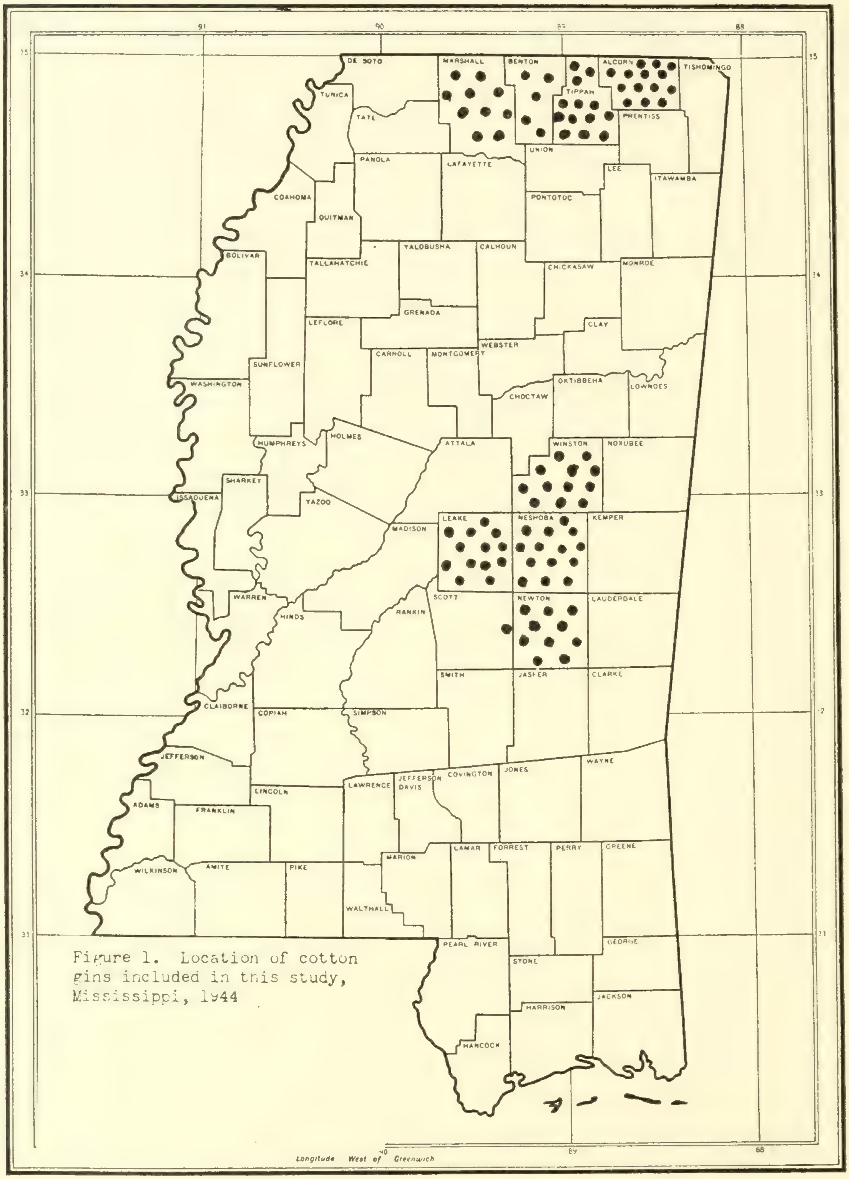
[2] Results of the first year's work were reported in Mississippi Experiment Station bulletin number 403, "Economic and Cost Study of Cotton Ginning in Central Mississippi", by D. Gray Miley and Arthur L. Roberts.

GENERAL CHARACTERISTICS OF THE GINS

Complete information was obtained for 50 gins in central Mississippi and 42 gins in the four counties in the northern

Table 1. The number, volume, size, age, capital investment and other factors of general information about the groups of gins included in this study, Mississippi, 1944

	Modern gins	Average gins	Sub-standard gins	All gins
Number of gins	23	39	30	92
Volume:				
Total bales ginned	44149	49712	28786	122647
Bales per gin	1920	1275	960	1333
Bales per gin stand	526	382	335	409
Age of gins, years	8	14	18	14
Number of gin stands	84	130	86	300
Stands per gin	3.6	3.3	3.0	3.3
Average number of saws per stand	80.0	76	74	76
Capital investment:				
Estimated replacement value, dollars	587523.41	857776.24	551390.30	1996689.95
Estimated present value, dollars	393929.52	463164.06	242120.90	1099214.48
Replacement value per gin, dollars	25544.96	21994.26	18379.68	21703.15
Present value per gin, dollars	17127.37	11876.00	8070.70	11947.98
Percent present value is of replacement value	67	54	44	55
Present value per stand, dollars	4689.64	3562.80	2815.36	3664.05
Present value per bale, ginned, dollars	8.92	9.32	8.41	8.96


91
90
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34
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32
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DE SOTO
MARSHALL
BENTON
TIPPAH
ALCORN
TISHOMINGO
TUNICA
TATE
PRENTISS
UNION
PANOLA
LAFAYETTE
LEE
ITAWAMBA
COAHOMA
PONTOTOC
QUITMAN
BOLIVAR
YALOBUSHA
CALHOUN
TALLAHATCHIE
CHICKASAW
MONROE
GRENADA
LEFLORE
CLAY
WEBSTER
CARROLL
MONTGOMERY
SUNFLOWER
OKTIBBEHA
WASHINGTON
LOWNDES
CHOCTAW
HUMPHREYS
HOLMES
ATTALA
WINSTON
NOXUBEE
SHARKEY
ISSAQUENA
YAZOO
LEAKE
NESHOBA
KEMPER
MADISON
SCOTT
NEWTON
LAUDERDALE
WARREN
HINDS
RANKIN
SMITH
JASPER
CLARKE
CLAIBORNE
COPIAH
SIMPSON
JEFFERSON
JONES
WAYNE
COVINGTON
JEFFERSON DAVIS
LAWRENCE
LINCOLN
ADAMS
FRANKLIN
LAMAR
FORREST
PERRY
GREENE
MARION
WILKINSON
AMITE
PIKE
WALTHALL
PEARL RIVER
GEORGE
STONE
JACKSON
HARRISON
HANCOCK
Longitude West of Greenwich

Figure 1. Location of cotton gins included in this study, Mississippi, 1944

part of the State. The location of these gins is shown in figure 1. On the basis of the detailed appraisal information, the gins were divided into three groups: (1) modern gins, those equipped to do the best job of ginning; (2) average gins, those gins that were considered to have about average ginning equipment; and (3) sub-standard gins, those gins that were poorly equipped and were in poor operating condition.[3] Some general information about the gins in each of these groups is given in table 1.

The 92 gins handled a total of 122,647 bales during the 1944 season, or an average of 1333 bales per gin and 409 bales per gin stand. The 23 modern gins had an average volume of 1920 bales per gin, while the 30 sub-standard gins handled an average of 960 bales per gin. The average age of the modern gins was 8 years, as compared to an average of 18 years for the sub-standard group and 14 years for all 92 gins. In size, the modern gins had an average of 3.6 stands and the sub-standard group an average of 3 stands per gin. All of the modern gins except one had 80 saws per gin stand. Many of the older gins in the sub-standard group had 70-saw stands and a few had 60-saw stands, the average for this group being 74 saws.

The estimated replacement value of these 92 gins is slightly under 2 million dollars, or an average of $21,703. The present value, however, averages only $11,948 or 55 percent of the replacement value. This means that the average gin in these areas has been in operation about half of its expected period of service. The present value of the modern gins is almost 67 percent of the replacement value, while for the sub-standard group the average is 44 percent.

The averages for the gins in the two areas were very similar and in most instances in this report they are combined. Where there are significant differences the data will be shown for both areas.

FINANCIAL SUMMARY

The cost of labor is by far the most important expense item connected with the operation of cotton gins. (Table 2.) The labor costs during the 1944 ginning season amounted to almost half of the total current expenses. The very high cost of hired labor services emphasize the importance of using labor as efficiently as possible. The influence of the efficient use of labor on the cost of operating gins will be discussed later in this report.

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[3] The appraisal work and the division of the gins into groups was done by technicians from the U. S. Cotton Ginning Laboratory, Stoneville, Mississippi.

During the past season good gin labor was not only hard to obtain but the wages received were fairly high compared to previous years. The other expense items that were of major importance were the cost of fuel or power, insurance, taxes, and maintenance and repairs. In all cases the current expenses were highest for the modern gins and progressively lower for the other two groups. The overhead expenses included salary for management, depreciation on the machinery and equipment, and interest on the investment. The depreciation was figured at 5 percent on the machinery and equipment and 4 percent on most of the buildings. In the few cases where there were all-steel or brick buildings, depreciation was calculated at 3 percent. Interest on the investment was figured at 4 percent per year

Table 2. Summary of average expenses and income for 88 gins, by groups, according to the condition of the ginning equipment, Mississippi, 1944

Item	23 Modern gins	37 Average gins	28 Sub-standard gins	All 88 gins
Current expenses:				
Labor	$1684.71	$1325.18	$ 936.49	$1295.47
Fuel or Power	452.33	331.70	279.65	346.67
Materials	84.56	75.94	60.73	73.35
Insurance	343.61	253.55	142.34	241.70
Taxes	220.48	174.99	115.26	167.88
Maintenance and repairs	457.57	452.85	321.46	412.24
Other costs	282.38	156.39	112.45	175.34
Total current expenses	$3525.64	$2770.49	$1968.38	$2712.64
Overhead:				
Salary for management	$ 656.26	$ 453.51	$ 485.21	$ 516.59
Depreciation	805.89	561.37	370.71	564.62
Interest (4 percent)	686.04	470.78	311.17	476.26
Total overhead	$2148.19	$1485.66	$1167.10	$1557.46
Total cost	$5673.82	$4256.16	$3135.48	$4270.10
Fees for ginning	$6901.04	$4655.58	$3142.59	$4761.05
Profit on ginning operation	$1227.21	$ 399.41	$ 7.11	$ 490.95
Net income from cottonseed	$2628.28	$1907.87	$1268.60	$1892.76
Net income from bagging and ties	$ 471.95	$ 294.03	$ 221.09	$ 317.32
Net profit	$4327.45	$2601.32	$1496.79	$2701.03

on the present value of the gin plant. As was the case with the current expenses, the overhead costs were highest for the modern gins and lowest for the gins in the sub-standard group. For the most part, the overhead costs do not have to be paid immediately.

The salary for management is that amount which is allowed to pay for the services of the person who is responsible for the direction of the gin enterprise. In many cases the owner was the operator, and in addition to managing the entire business he did a considerable part of the actual work connected with operating the gin plant. In other cases the owner did most of the work of operating the gin and exercised full managerial supervision of the business. In arriving at a figure to enter as a salary for management, an attempt was made to arrive at an estimate of what it would cost to hire someone at going wage rates to perform the managerial and other functions actually handled by the owner of the business. The average estimate for all of the gins amounted to slightly over $500 per gin.

Depreciation is a cost that has to be met sooner or later if a gin operator is to continue in business for any length of time. If reserves for taking care of the depreciation are not set aside currently, the present gin plant will go out of existence when the machinery and equipment is worn out. The owners of gins can take the amount alloted for depreciation and "live it up" if they care to, but if a majority of the operators of gins do not set aside sufficient funds to replace their plants the entire ginning industry will gradually go down. This cost of depreciation is, therefore, one that has to be met as the ginning industry goes along if it is to maintain itself over any period of time and perform a satisfactory service.

The item of interest on the investment is another cost that has to be met if capital is to continue to flow into the ginning industry in sufficient quantities to maintain the industry at its present level. As has already been pointed out, the amount of capital invested in gin plants is fairly high in comparison to the amount of time the facilities are used during any one season. Ginners or other investors do not put capital into gin plants unless there is an opportunity to realize at least as much return as they could realize from what would be considered ordinarily safe investments. In other words, if a person can derive 3 percent interest on government bonds he is not likely to put his money in a somewhat risky enterprise that promises to earn no more than 3 percent. From this standpoint, in order to have capital continue to flow into the ginning industry in sufficient quantities to maintain the industry at its present level, it is necessary that the ginning industry offer at least as good an opportunity as other investment possibilities. For the 88 gins included in this study the average interest on investment was $476.

The combined overhead costs amounted to $1557 for all of the gins. When the overhead and current expenses are combined, the average gin had a total cost of $4270 during the 1944 season. This is about $700 higher than the average cost for the 43 gins studied in 1943. Practically all items of expense were higher during the 1944 season than for the previous year. These higher costs, however, were more than completely offset by increased income from performing the ginning service. The major part of this increase in income was due to the increased amount of cotton ginned. The average gin in 1944 had a volume of 1333 bales, compared with an average of 1053 bales for the previous season.

After allowing for all current expenses, salary for management, depreciation, and interest on the investment, the average gin in 1944 returned a net profit of $491 on the ginning operation. The modern gins had a net profit of $1227 whereas, the sub-standard gins had a profit of only $7.00. In arriving at these net profit figures on the ginning operation, the entire costs of operating the business were charged against the income received from the performance of the ginning service.

In addition, the ginners had what they made on handling cottonseed and bagging and ties. The handling of seed was quite profitable during the past season and the average ginner made $1893 net income from handling cottonseed. Almost all ginners make a net income of around $0.25 per bale for bagging and ties. This item amounted to an average of $317 per gin. When all of these items were combined, the average gin operator had a net profit of $2701 during the 1944 season. It should be emphasized that this amount of profit was made after allowing a reasonable salary for management, depreciation on the gin plant, and 4 percent interest on the investment. For the modern gins the net profit amounted to $4327 and for the substandard gins the profit was $1497.

It is readily observed from this summary that even though almost all items of expense were higher in 1944 than they had been previously, the income also was considerably higher and resulted in all groups of gins returning a reasonable profit for the gin operations of this season.

COST AND INCOME PER BALE

The average cost for ginning a bale of cotton was $3.10. (Table 3.) The average income for performing the ginning service was $3.46 per bale, thus leaving a net profit of $0.36 per bale on the ginning operation. In addition to the profit made on the ginning operation, the average gin operator had a net income of $1.37 per bale from cottonseed and made $0.23 per bale from bagging and ties. When these three items of

Table 3. Summary of the cost and income per bale of cotton ginned for 88 cotton gins, by groups, according to the condition of the ginning equipment Mississippi, 1944

Item	23 Modern gins	37 Average gins	28 Sub-standard gins	All 88 gins
Current expenses:				
Labor	$ .88	$1.02	$ .91	$ .94
Fuel or power	.24	.25	.27	.25
Materials	.04	.06	.05	.05
Insurance	.18	.19	.14	.18
Taxes	.11	.13	.12	.12
Maintenance and repairs	.24	.35	.31	.30
Other costs	.15	.12	.11	.13
Total current expenses	$1.84	$2.12	$1.91	$1.97
Overhead:				
Salary for management	$ .34	$ .35	$ .47	$ .38
Depreciation	.42	.43	.36	.41
Interest (4 percent)	.36	.36	.30	.35
Total overhead	$1.12	$1.14	$1.14	$1.13
Total cost	$2.96	$3.26	$3.05	$3.10
Fees for ginning	$3.60	$3.57	$3.06	$3.46
Profit on ginning operation	$ .64	$ .31	$ .01	$ .36
Net income from cottonseed	$1.37	$1.46	$1.23	$1.37
Net income from bagging and ties	$ .25	$ .23	$ .22	$ .23
Net profit	$2.25	$1.99	$1.46	$1.96

income are combined, the average operator received a net profit of $1.96 for each bale ginned during the 1944 season. The average net profit for the 43 gins included in the study during the 1943 season was $1.23 per bale. The net profit during 1944 ranged from $2.25 per bale for the modern gins to $1.46 per bale for the sub-standard gins.

It is interesting to note that the fees charged for performing the ginning services were somewhat higher for the modern gins than for those in the sub-standard group. On the other hand the average cost for performing the ginning services was lowest for the modern gins, thus leaving a net profit of $0.64 per bale for the modern gins and only $0.01 per bale for the sub-standard gins. Apparently the modern gins were able to charge a higher rate for the ginning service and still maintain a much higher average volume than the sub-standard gins even though the latter group charged a lower rate for this service. This is contrary to the situation found in the Central Area during the previous season when the sub-standard gins charged a little higher rate for the ginning service than the more modern gins. For the entire group of gins during the 1944 season, the average current expense was $1.97 per bale. Almost 50 percent of the current expenses was made up of labor costs. Fuel or power costs accounted for about 12 percent of the current expenses, and maintenance and repairs about 15 percent. The remaining costs were made up of insurance, taxes, and minor miscellaneous items.

The total overhead costs amounted to $1.13 per bale. In other words, of the total cost of $3.10 for performing the ginning service, the overhead costs were 36 percent and the current expenses 64 percent of the total. Thus as has already been emphasized, the overhead charges necessary to manage and take care of the investment in a gin plant constitute a considerable proportion of the total costs.

LABOR, FUEL AND POWER REQUIREMENTS FOR GINNING

It required an average of 2.9 hours of man labor, including the time of the manager, to gin a bale of cotton during the 1944 season. (Table 4.) The modern gins used 2.6 hours per bale and to do the same job required an average of 3.3 hours for the sub-standard gins.

There were 40 gins that used Diesel engines as a source of power. These engines used an average of 1.6 gallons of Diesel fuel per bale ginned. The modern gins used an average of 1.4 gallons per bale while at the same time the sub-standard group used 1.8 gallons.

The 15 gins that used electric power consumed an average of 19 kilowatt hours per bale of cotton ginned. Here too the modern gins consumed the smaller quantity, the average for this group being 17.2 kilowatt hours as compared with 25.1 for the sub-standard group. Fourteen of the 15 electrically operated gins used in this analysis were in the North Mississippi Area where TVA power is available.

There were 10 other fuel burning engines that used either tractor fuel or fuel oil. There were not sufficient numbers of

Table 4. Quantities of labor, fuel and power used in the ginning operation, by groups of gins, Mississippi, 1944

Item	Modern gins	Average gins	Sub-standard gins	Average all gins
Labor:				
Number of gins	23	36	30	89
Hours per gin	4950	3729	3156	3851
Hours per bale	2.6	2.7	3.3	2.9
Diesel fuel:				
Number of gins	13	19	8	40
Gallons per gin	3418	2427	2252	2714
Gallons per bale	1.4	1.8	1.8	1.6
Electric power:				
Number of gins	4	8	3	15
KWH per gin	42860	24573	19764	28488
KWH per bale	17.2	19.5	25.1	19.0
Fuel oil or tractor fuel:				
Number of gins	1	2	7	10
Gallons per gin	2736	3425	2900	2988
Gallons per bale	3.2	3.3	3.3	3.3
Gasoline:				
Number of gins	2	5	2	9
Gallons per gin	4612	3559	2262	3505
Gallons per bale	3.3	3.0	3.0	3.1

these to give reliable averages for all the groups but the combined average was 3.3 gallons of fuel per bale ginned.

Power plants that used gasoline for fuel were used in 9 gins, all of which were in the Central Mississippi Area. These gins burned an average of 3.1 gallons of gasoline for each bale ginned.

The average quantities of fuel and the average hours of labor required to operate cotton gins with the same type of equipment do not vary greatly from year to year. Consequently, the average figures for labor and fuel requirements can be used for several years to make estimates of the cost of operating gins.

FACTORS THAT INFLUENCE GINNING INCOME

Size and Volume

As was pointed out earlier in this report the cotton gin is used for only a short period out of each year. Because of the relatively high investment in plant and equipment and this short period of use, it is necessary that a gin plant be operated efficiently and at near capacity throughout the ginning season if a reasonable return is to be made from the operation. The importance of this fact is shown in table 5 where the gins have been grouped by size, as measured by number of stands, and by volume in terms of bales ginned.

Small two-stand gins that ginned less than 600 bales during the season lost an average of $1.15 for every bale ginned. On the other hand, the two-stand gins that ginned over 900 bales made a net income of $0.58 for each bale ginned. As the volume increased the total cost per bale as well as the hours of labor per bale declined significantly. Because of the relatively large overhead cost involved, small gins have difficulty making any profit with a volume that runs less than 500 bales per gin stand.

The relationship for three-stand gins was the same as for the smaller gins. Those that ginned less than 1000 bales had high average costs, substantial average losses, and used a large amount of labor per bale. On the other hand the gins that handled over 1400 bales made an average net income of $0.81 per bale. The three-stand gins had to have an average of about

Table 5. The relationship of the number of bales of cotton ginned to the cost, income, and other factors of gin operation for various sizes of gins, Mississippi, 1944

Size and volume	No. of gins	Bales per gin	Total cost per bale	Net income per bale	Net income per gin	Hours of labor per bale
2 stands:						
Bales ginned:						
Under 600	4	511	$4.63	$—1.15	$—574.01	4.03
600 - 900	5	742	4.17	—.60	—422.14	3.35
Over 900	5	978	3.07	.58	578.91	2.86
3 stands:						
Bales ginned:						
Under 1000	10	636	$5.18	$—1.56	$—867.98	4.60
1000 - 1400	15	1178	3.33	.34	539.02	2.87
Over 1400	16	1627	2.73	.81	1346.16	2.40
4 or more stands:						
Bales ginned:						
Under 1300	10	1035	$4.21	$ —.72	$—552.37	3.11
1300 - 2000	12	1572	3.04	.43	725.76	2.66
Over 2000	11	2488	2.81	.75	1965.43	2.54

450 bales per stand before they returned an average net income. The additional overhead cost necessary to operate a three-stand gin over that which is required for a two-stand gin is not large enough to require the same number of bales per stand for a "break even" volume.

The same relationship between volume, cost, and income holds true for the large gins. That is, the four-stand gins with large volumes had lower costs per bale, used less labor per bale, and made more profit than the low volume gins. The "break even" volume for these larger gins was around 400 bales per gin stand.

The general relationship of volume of ginnings and the total cost per bale is shown in figure 2. Other factors, such as labor efficiency, and type and condition of the machinery and power plant, cause some scatter of the individual gins around the general trend line but there can be little question about the fact that the cost of ginning declines as the volume increases. The decline is very sharp until a volume of around 1000 bales is reached. From about 1000 to around 2000 the decline continues downward but at a decreasing rate. Above 2000 bales the costs tended to average about the same. This may be due to the fact that there were not enough gins with high volumes to set a definite trend line or it may be that additional economies are hard to realize after a volume of around 2000 bales is reached with a four-stand gin.

The operation of a gin of any size requires a crew that is governed by the size of the gin. This basic or skeleton crew usually has to be on hand during most of the ginning season. Therefore, the cost of this crew, as well as the interest and depreciation on the gin plant, go on whether 500 or 2000 bales are handled. But if a four-stand gin has around 2000 to 2500 bales to gin during a normal season the labor and the equipment can be used to capacity for the major part of the season. If a bale can be ginned every 15 minutes during a 10-hour day, 40 bales can be ginned per day. At this rate 2000 bales would give 50 full 10-hour days at near capacity. When above this amount is handled it means that the labor has to be worked overtime or a night crew has to be employed. Because of these factors the further reduction of the average per bale costs be-

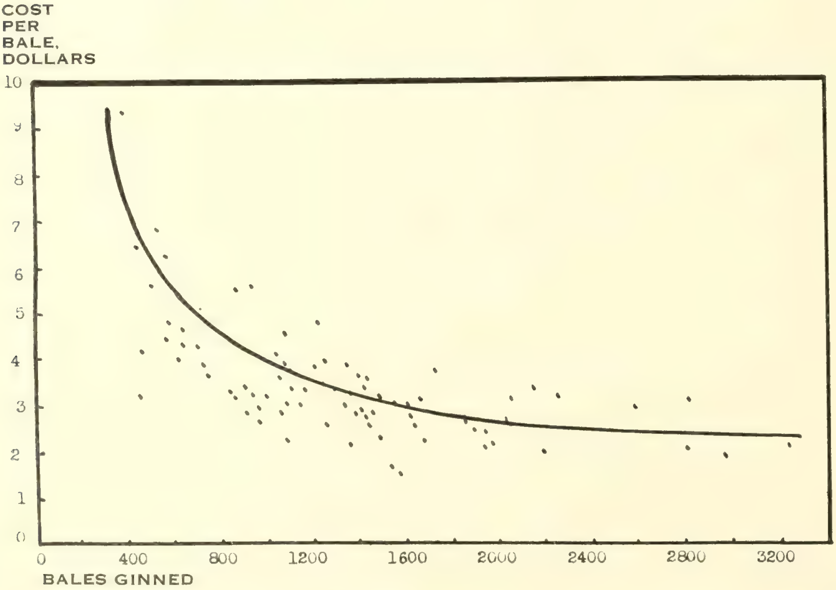

Figure 2. Relationships of the volume of ginnings to the total cost per bale.

comes more and more difficult after a volume of 2000 to 2500 bales is reached for a four-stand gin. Very likely the costs can be reduced still more with larger gins serving larger territories which furnish proportionately larger volumes. The same result could be brought about if the ginning season could be extended to cover a longer period. It might be economically possible for some of the larger gins to provide storage space for some of the seed cotton during the peak harvesting period and gin it during slack periods. The cost of providing such storage would have to be low enough to equal the reduced cost brought about by the more efficient operation, after allowing for the cost of present methods of storage, or the total cost of ginning might be increased. In other words, cotton has to be stored somewhere and it may be that a certain amount of storage could be provided at the gin at low enough cost to bring about economies in the performance of the ginning service. Such storage would have to be constructed so that the cotton or the seed would not deteriorate and would have to be situated so that the cotton could be handled by the suction system of the gin plant. Perhaps one of the greatest drawbacks to such a plan would be the reluctance of producers to wait for any length of time to get their cotton ginned.

Use of Labor

The efficient use of the labor that is employed to run the gin plant is very important if a profit is to be made on the operation. One of the most important ways to increase labor effiency is to be sure of enough volume to keep the force fully employed. But for gins that have about the same volume of ginnings some use nearly twice as much labor as others. (See table 6.) For example, 8 gins that had a volume of less than 1000 bales used an average of 2.5 hours of labor per bale ginned, while 8 other gins in the same volume group used an average of 5.5 hours of labor for each bale ginned. The former group had an average net profit of $0.09 per bale and the latter a net loss of $2.60 for every bale ginned. Of course not all this loss was due to the inefficient use of labor, but there can be little question that it was a major factor in increasing the cost of operation and thus reducing the profits.

Table 6. The relationship of the hours of labor per bale of cotton ginned to the cost, income, and other factors of gin operation for various volume groups, all sizes of gins combined, Mississippi, 1944

Group	No. of gins	Bales per gin	Hours of labor per bale	Total cost per bale	Net income per bale	Net income per gin	Average number of gin stands
Ginned Less than 1000 bales:							
Hours per bale:							
1.9 - 3.0	8	831	2.5	$ 3.46	$ .09	$ 109.87	2.8
3.1 - 4.0	8	680	3.6	3.97	—.36	—186.46	2.2
4.1 - 7.4	8	585	5.5	6.15	—2.60	—1393.77	3.0
Ginned 1000-1500 bales:							
Hours per bale:							
1.8 - 2.9	10	1250	2.5	$ 3.00	$ .55	$ 689.13	3.0
3.0 - 3.5	10	1243	3.1	3.39	.26	524.92	3.2
3.6 - 5.1	9	1247	4.1	3.73	—.08	—42.01	3.8
Ginned over 1500 bales:							
Hours per bale:							
1.3 - 2.0	8	2098	1.6	$ 2.16	$ 1.44	$ 3031.18	3.5
2.1 - 2.6	8	2020	2.5	2.78	.85	1783.14	4.0
2.7 - 3.8	11	1993	3.1	3.13	.34	672.20	3.9

The group of gins that averaged about 1250 bales also had considerable variation in the amount of labor used. Those that used an average of 2.5 hours of labor per bale had a net profit of $0.55 for each bale ginned. On the other hand, those gins with about the same volume but which used 4.1 hours of labor per bale had a net loss of $0.08 for each bale ginned. The same relationship held for the gins that averaged ginning around 2000 bales. Those that used the least labor per bale made a net profit of $1.44 for each bale ginned; whereas, those using the highest amount of labor had a net profit of only $0.34 per bale. The economics that go with the larger volumes can be reduced materially by the inefficient use of labor.

One of the big obstacles of the ginning business is that it furnishes employment for only a short period of the year. Consequently the labor has to be brought in from farms or other places of employment to be used temporarily in the operation of the gin. Under these conditions it is always difficult to secure and keep competent labor; this makes it all the more important that the ginner hire only the amount of help needed when it is needed and if possible, use the same workers year after year so they can be trained to do their particular job effectively.

Power Costs

The decision as to what type of power to use in a gin plant may determine the future financial success of the operation. It has already been pointed out that small gins with low volumes almost always lose money. This is especially true for small gins that have heavy investments in their power plants. The overhead becomes entirely too burdensome for the smaller gins to carry when they have a large amount of capital invested in a power plant.

Diesel type power was used in 41 of the gins included in this study. (Table 7.) Four of these were two-stand gins, and they had an average net loss of $0.23 per bale ginned. The rather low fuel cost of $0.20 per bale was offset by the relatively high cost of $0.26 per bale for depreciation and interest on the investment in the power plant. The larger Diesel powered gins with proportionately higher volumes had progressively lower fuel as well as interest and depreciation costs. The four-stand Diesel operated gins with an average volume of around 1900 bales used only $0.18 worth of fuel per bale. The interest and depreciation charge was $0.16, making an average cost of $0.34 per bale for the large gins that used Diesel power. The average power cost for the Diesel operated gins was $0.18 per bale for fuel and $0.20 for interest and depreciation or a total of $0.38 for each bale ginned.

The use of electric power was limited almost entirely to the North Mississippi Area where TVA power is available. The 19 gins using electric power had almost the same average volume as the Diesel powered gins and had an average power cost of $0.40 per bale and an interest and depreciation cost of $0.07 making a total of $0.47 per bale. However, the total cost was lower and the profit per bale higher for the electrically operat-

Table 7. Relationship of the type of power to average cost, income and other factors of gin operation, Mississippi, 1944

Group	No. of gins	Bales ginned	Capital value of power plant	Cost of power		Total cost per bale	Profit per bale
				Fuel cost	Interest and Depreciation		
Diesel type power:							
2-stand gins	4	808	$2060.16	$ .20	$ .26	$ 3.82	$—.23
3-stand gins	21	1270	2537.72	.17	.21	3.62	.04
4-stand gins	16	1905	3351.31	.18	.16	3.33	.16
Average	41	1473	$2808.63	$ .18	$ .20	$ 3.53	$ .06
Electric power:							
3-stand gins	5	1286	$ 992.47	$ .34	$ .08	$ 3.32	$ .20
4-stands and over	14	1551	971.33	.42	.07	3.25	.29
Average	19	1482	$ 976.89	$ .40	$ .07	$ 3.27	$ .26
Gasoline type power:							
2-stand gins	3	851	$ 907.89	$ .48	$ .10	$ 3.39	$ .15
3-stand gins	7	1225	1771.65	.41	.13	3.11	.38
Average	10	1113	$1512.55	$ .43	$ .12	$ 3.20	$ .31
Tractor fuel type power:							
2-stand gins	3	616	$ 648.75	$ .33	$ .09	$ 3.93	$—.50
3-stand gins	4	840	1260.31	.31	.17	4.35	—.82
Average	7	744	$ 998.21	$ .32	$ .14	$ 4.17	$—.68
Steam type power:							
2-stand gins	2	979	$ 588.95	$ .65	$ .07	$ 4.28	$—.57
3-stand gins	2	1183	811.31	.66	.08	3.60	—.02
4-stand gins	2	1228	676.59	.37	.05	3.36	.15
Average	6	1069	$ 692.28	$ .56	$ .06	$ 3.75	$—.15

ed gins than for the gins operated by Diesel power. Electric power cost more per bale than did Diesel fuel, but the investment in the average electric motor was only about one-third as much as in the Diesel type motors. A further factor to consider is the amount of labor required to operate a Diesel type motor as compared with an electric motor. The large Diesel type engines require a considerable amount of engineering ability and supervision for the most efficient operation. On the other hand, the electric motors require very little more than the ability to turn a switch. This difference in labor requirements was one of the main factors accounting for the lower total costs of the electrically powered gins.

The 10 gins that used gasoline engines had an average cost of $0.43 per bale for gasoline and $0.12 for interest and depreciation on the power plant making a total cost of $0.55 per bale. The average investment in gasoline engines was slightly over $1500 per gin. The gins using gasoline type of power had a lower total cost per bale than any of the other groups. This lower cost was accomplished with a smaller volume than either the electric or Diesel power groups. No doubt there are other factors that accounted for the favorable showing of these gasoline powered gins, but all the studies made so far indicate that the smaller gins with somewhere near average volumes have a greater chance of showing a profit when they make efficient use of a good gasoline engine.

The group of 7 gins that used tractor fuel or fuel oil had a fairly low average volume of 744 bales per gin. This low volume probably was the major factor contributing to the rather substantial loss shown for this group. The average cost of fuel was $0.32 per bale and for interest and depreciation $0.14, making a total cost for the other fuel burners of $0.56 per bale.

The final group shows six gins that use steam power. The average cost for steam power was higher than for any of the other groups. The major item of cost was fuel for the burners. The cost of wood and other fuel for steam engines has been very high during the war period. The average cost of fuel for the six gins was $0.56 per bale. On the other hand, interest and depreciation charges were lower than for any of the other groups, averaging only $0.06 per bale. The total per bale cost for the steam powered gins was $0.62. The two large four-stand gins using steam power compared favorably with the same size gins in the other groups in both cost and profit per bale. A major factor to be considered in the use of steam power is that the service of a full time fireman or engineer is required for the efficient operation of the power plant. To have a complete basis for comparison, the services of such a person would have to be added to the actual power costs. The steam engines that are still in use are all old and will no doubt be replaced by other types as soon as they are no longer serviceable. Steam powered gins have been decreasing at a rapid rate during recent years.

The Use of Capital

It is almost impossible for small gins with relatively high capital investments to return a net profit on the ginning operation. (Table 8.) In order to show the influence of the efficient use of capital on income, an attempt was made to eliminate at least part of the influence of the volume of ginnings. This was accomplished by sorting the gins into groups according to the volume ginned and then re-sorting on the basis of the capital invested per bale of cotton ginned. The gins that had less than 1000 bales and had an average investment of over $14 for each bale ginned, had a net loss of $2.35 per bale. On the other hand, the gins that had less than 1000 bales but which

Table 8. The relationship of the capital investment per bale of cotton ginned to cost, income and other factors of gin operation, Mississippi, 1944

	No. of gins	Bales per gin	Average investment per bale	Average investment per gin	Total cost per bale	Net income per bale	Hours of labor per bale
Ginned below 1000 bales:							
Investment per bale:							
Below $9.00	8	874	$ 7.74	$ 6734.41	$ 3.60	$ .03	3.2
$9.00 - $14.00	10	682	11.16	7660.30	3.91	—.41	3.6
Over $14.00	10	581	19.49	11246.70	$ 5.89	—2.35	4.9
Ginned 1000-1500 bales:							
Investment per bale:							
Below $8.50	9	1352	$ 6.97	$ 9374.69	$ 2.81	$ .73	3.1
$8.50 - $10.00	13	1184	9.34	11063.29	3.57	.04	3.3
Over $10.00	11	1206	10.95	13131.81	3.71	.05	2.8
Ginned over 1500 bales:							
Investment per bale:							
Below $6.00	10	2020	$ 5.18	$10475.95	$ 2.46	$ .99	2.3
$6.00 - $9.00	11	1974	7.45	14798.25	2.80	.73	2.3
Over $9.00	10	2028	10.30	20797.11	2.96	.64	2.6

had less than $9.00 invested for each bale ginned, succeeded in making a small net profit. Part of this difference was probably accounted for by the fact that the sorting procedure used did not result in getting gins in each group with the same average volume. In the second group, however, the volume was about the same for each of the sub-groups. In this case the gins that had less than $8.50 invested for each bale ginned made a net profit of $0.73 per bale, whereas those that had over $10.00 invested for each bale ginned made only $0.05 per bale.

In the group with the highest volume, the relationship was very much the same. In this case, however, each group of gins returned a net profit but the group with the smallest amount invested for each bale ginned made the highest average profit.

It will be observed that in each group shown the gins with the highest investment per bale had the highest total investment per gin and those with the lowest investment per bale had the smallest total investment per gin; also in each case, the gins with the lowest investment per bale always had the lowest total cost per bale. This was true for every volume group. As the usual thing, the gins with the highest investment are the newer, more modern gin plants. From this standpoint they are better equipped to do an efficient job of ginning than those with small investments. However, from the standpoint of making a return from the ginning enterprise, the fact that a person has a new, modern gin plant with a high capital investment does not in any way insure the financial success of the enterprise. The success, and consequently the eventual establishment, of large, modern gin plants will be determined very largely by the ability of these plants to secure sufficient volume to insure the financial success of the operation.

Perhaps one of the major reasons why the majority of cotton gins in the Hill Areas of Mississippi have not put in modern drying, cleaning and other equipment is the fact that their volumes are not sufficient to return income enough to pay for the necessary capital to make these improvements.

FACTORS THAT INFLUENCE COTTON QUALITY

Cotton growers can maintain the quality of cotton they produce by adopting improved methods of harvesting, handling, and by selecting gins adequately equipped and efficiently managed. During the past decade farmers have begun to realize premiums for high grade cotton. This, perhaps, is due largely to closer attention to selection of improved varieties, better harvesting and ginning methods, and market values of the various grades of cotton produced.

Measures of Cotton Quality

Foreign matter content, color, and ginning preparation are the major factors of grade and they all contribute to the spinning utility of cotton lint. Ginning preparation and the average value of lint per pound are two measures of ginning quality used in this analysis of the performance of the three groups of gins in the study.

Preparation[4] is a term used to describe the degree of smoothness or the relative napiness or neppiness of ginned lint. Although the condition of seed cotton when ginned has an important effect on preparation, the manner in which it is ginned and the condition of ginning equipment frequently determine whether the preparation of lint is to be smooth or rough.

All gins used in the study were selected in areas of Mississippi where cotton varieties, soil, climatic conditions, tillage and harvesting methods, and marketing practices are unusually uniform. It has, therefore, been assumed that the principal differences in ginning preparation and in average value of lint cotton per pound would be the result of differences in the adequacy and condition of ginning machinery.

Ginning Performance Based on Official Classification

Since this part of the study is dependent on the official classification of samples submitted from each gin, the number of gins used varies slightly from the number used in the cost analysis section. All gins used in this analysis, however, were used in that section.

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[4] The Classification of Cotton, Bureau of Agricultural Economics, United States Department of Agriculture, Miscellaneous publication No. 310, 54 pp., illus., 1938.

Of the 73 gins included in this section of the study, 21 were classified as modern, 30 as average, and 22 as sub-standard. This grouping was made on the basis of the condition and adequacy of machinery in the gins. It is recognized, however, that method of operation of gin equipment may in some cases nullify the good ginning job expected from a gin having modern gin machinery.

Cotton in Mississippi at the beginning of the 1944 season was somewhat green and evidently contained too much moisture for best ginning results. This condition usually results in an increase in the proportion of roughly ginned cotton. Tests have shown that driers are an effective factor in reducing rough preparation for cotton containing an excessive amount of moisture. Only two of the gins included in the study were equipped with driers for the proper conditioning of seed cotton for ginning.

Effect of Driers on Ginning Preparation

A comparison of rough preparation for gins equipped with driers and those not so equipped is shown in table 9. Gins using driers had only 3.7 percent rough preparation. Had all gins in Mississippi been equipped with driers during the season, the benefits to cotton growers could have meant many thousands of dollars on the basis of these results.

Cotton driers, however, are comparatively expensive equipment and are usually found only in the strictly modern gins. Ginners whose volume of ginning is small usually find that the expense of driers is prohibitive and the only alternative for

Table 9. Proportion of rough ginned cotton for gins equipped with driers and not equipped with driers in selected areas of Mississippi, crop of 1944[1]

Item	Gins having driers	Gins not having driers
Total samples classed	2,725	65,994
Samples reduced 1 or more grades	100	4,459
Percentage rough preparation	3.7	6.8

[1] Based on official classification of samples submitted.

the grower is to harvest his cotton only when it is dry or patronize gins having this improved equipment.

Based on preliminary figures of the Office of Marketing Services, approximately 200,000 equivalent 500 pound bales of the 1944 cotton crop in Mississippi was reduced one or more grades because of rough ginning. It is believed that a major portion of this reduction in grade was a result of ginning cotton containing excessive moisture. Some of the reductions in grade were likely caused by too fast feeding of cotton to the gin stands as will be shown in a later table.

Factors of Gin Operation Influencing Ginning Preparation

In table 10 is set forth some factors of gin operation that have an important influence on ginning preparation. These are (1) density of seed roll, (2) saw speed, (3) condition of saws and (4) condition of ribs.

One-third of the modern gins studied ginned with loose seed rolls. While 27 percent and 23 percent of the average and sub-

Table 10. Distribution of gins in selected areas of Mississippi according to factors of gin operation affecting ginning preparation, by type of gin, crop of 1944

Item	Group					
	Modern		Average		Sub-standard	
	Number of gins	Percent	Number of gins	Percent	Number of gins	Percent
Density of seed roll:						
Loose	7	33	7	27	5	23
Medium	14	67	22	70	16	72
Tight	....	0	1	3	1	5
Total	21	100	30	100	22	100
Saw speed, r.p.m.:						
600 and above	14	67	10	33	4	18
400 to 599	7	33	19	64	15	68
399 and below	....	0	1	3	3	14
Total	21	100	30	100	22	100
Condition of saws:						
Good	14	67	18	60	5	23
Fair	7	33	10	33	7	32
Poor	....	0	2	7	10	45
Total	21	100	30	100	22	100
Condition of ribs:						
Good	15	71	11	37	9	41
Fair	6	29	16	53	7	32
Poor	....	0	3	10	6	27
Total	21	100	30	100	22	100

standard gins, respectively, operated with loose seed rolls. Two-thirds of the modern gins operated with medium seed rolls and 70 percent and 72 percent of the average and sub-standard gins, respectively, operated in this manner. None of the modern gins operated with tight seed rolls while a small percent of both the average and sub-standard gins operated with tight seed rolls.

It is imperative that gins using saw speeds of 600 revolutions-per-minute and above maintain loose seed rolls and use proper seed board settings if a good job of ginning is to be done. This speed coupled with the tight seed rolls causes considerable damage to cotton lint.

Two-thirds of the modern gins used saw speeds of 600 revolutions-per-minute and above and about the same proportion of the other two groups of gins used speeds of 400 to 599.

A major proportion of the modern gins maintained both saws and ribs in good condition. The average sub-standard gins had a considerable proportion of both saws and ribs in fair to poor condition. These factors of gin operation no doubt had quite an influence on the results of ginning as shown in the following tables.[5]

Experiments have shown that as seed rolls are allowed to approach a medium and tight condition, short fibers are pulled from the seed. This results in a slightly higher percentage of lint being produced because a larger proportion of the short fiber is removed from the seed. But manufacturing waste is higher for such cotton and staple length may be reduced because of greater irregularity in fiber length. These practices in ginning may also increase the content of motes and seed fragments in the ginned lint. This, of necessity, brings about a reduction in the class of cotton and, therefore, a loss in grade to the farmer. The increase in lint turnout does not ordinarily offset the loss resulting from the reduction in grade.

Lint Turnout

It is not surprising that, as shown in table 11, the lint percentage turnout for the three groups of gins is slightly higher for the sub-standard gins. The percentages being 38.1, 38.3 and 39.1 for the modern, average, and sub-standard gins, respectively. These percentages of lint turnout are significant since all gins having average staple lengths of less than one inch were excluded in order that the varieties involved would be almost in exact proportion for each gin group.[6] As a usual practice modern gins ginned with less dense seed rolls than did either the average or sub-standard gins.

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[5] Bennett. Charles A., Baggette, F. L., Gerdes, F. L., Modernizing Cotton Gins, USDA, Farmers Bulletin No. 1802, 55 pp., illus., 1939.

Table 11. Lint percentage for cotton ginned in selected areas of Mississippi, crop of 1944, by type of gin establishment

Group	Samples classed	Lint percentage
Modern	27525	38.1
Average	29154	38.3
Sub-standard	12040	39.1

Age of Gins as a Factor Influencing Ginning Preparation

Since age and use bring about worn and outmoded machinery, a comparison of ginning preparation was made for gins built during the period 1937 through 1944 and for gins built prior to 1937, table 12. This grouping of gins was made without regard to whether the gins had been placed in modern, average, and sub-standard groups, but was made purely according to the age of the gins. However, about three-fourths of the gins shown were built during the period 1937 through 1944 and were from the modern group.

Age seems to have a definite influence on ginning preparation as the gins built during and since 1937 show only 4.9 percent rough preparation while those built prior to 1937 average 7.2 percent rough ginned cotton. The gins built since 1937 were assumed to have installed new equipment. Some of

Table 12. Age of gins as a factor influencing ginning preparation, in selected areas of Mississippi, crop of 1944

Period during which gin was built	Number gins	Samples classed	Samples reduced 1 or more grades	Rough preparation
			Bales	Percent
1937 to 1944	16	18014	876	4.9
Prior to 1937	57	50705	3634	7.2

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[6] Bennett, Charles A. and Gerdes, Francis L., Effects of Feeds and Saw Speeds on Cotton Turn-out and Quality, USDA, Leaflet No. 151, 4 pp., illus., 1927.

the gins placed in the building prior to 1937 have been overhauled in recent years but are still considered to be inadequate in a number of respects.

Distribution of Gins According to Rough Preparation

Rough preparation for gins used in the study ranged from zero to about 21 percent. (Table 13.) Only two gins, however, had rough preparation in excess of 18 percent. These gins were in the sub-standard group. Approximately 90 percent of the modern gins were in that group having less than 9 percent rough preparation. The average and sub-standard groups each had 73 percent of the gins in this preparation range. Those gins having from 9 to 17.9 percent of rough preparation composed 10 percent, 27 percent, and 18 percent, respectively, of modern, average, and sub-standard gins.

Table 13. Distribution of gins in selected areas of Mississippi, according to the proportion of roughly ginned cotton, by type of gin establishment, crop of 1944

Gin group	Rough Preparation					
	0 to 8.9		9.0 to 17.9		18.0 and above	
	Number of gins	Percent	Number of gins	Percent	Number of gins	Percent
Modern	19	90	2	10	....	0
Average	22	73	8	27	....	0
Sub-standard	16	73	4	18	2	9

In order to compare the effect of condition of gin saws and ribs on ginning preparation, gins submitting samples from 50 percent or more of the bales ginned during the 1944 season, were divided into two groups according to condition of saws and ribs. Those gins having both saws and ribs in good condition had 5.4 percent rough preparation. Gins with either or both saws and ribs in fair to poor condition had 7.3 percent rough preparation.

The average value of lint per pound was 22.22 cents for the gins having saws and ribs in good condition and 22.13 cents per pound for gins having saws and ribs in fair to poor condition, table 14.

Table 14. Average value of lint and percentage of roughly ginned cotton as affected by conditions of gin saws and ribs at ginning establishments in selected areas of Mississippi, crop of 1944[1]

Condition of saws and ribs	Samples classed	Samples roughly ginned		Average value of lint per pound[2]
	Number	Number	Percent	Cents
Good	13694	739	5.4	22.22
Fair to poor	40310	2959	7.3	22.13

[1] Applies only to those gins submitting fifty percent or more of ginnings.

[2] Based on average premiums and discounts prevailing in the 10 designated spot markets, August 1944 through March 1945, staples 13/16 inch through 1-3/16 inches. Memphis premiums and discounts, for same period, were used for staples 1-1/8 inches and longer.

Grade index, average staple length and the proportion of rough preparation were determined for gins having overhead cleaners and those not having such cleaners. (Table 15.) The gins were divided without regard to their original grouping. Fifteen gins had overhead cleaners and 48 lacked this type of equipment. The advantages for overhead cleaners as here shown are almost nil.

Table 15. Grade index, average staple length and preparation of cotton ginned on gins equipped with overhead cleaners and not equipped with overhead cleaners in selected areas of Mississippi, crop of 1944

Item	Number gins	Bales ginned	Grade index[1]	Average staple length[2]	Rough preparation[3]	
					Bales	Percent
Gins equipped with overhead cleaners	15	12419	99.0	33.2	760	6.1
Gins not equipped with overhead cleaners	58	56300	98.9	33.3	3695	6.6

[1] Middling white is 100. Larger index numbers indicate higher grades.

[2] In 32nd inches.

[3] Samples reduced one or more grades because of rough preparation.

The gins using overhead cleaners produced a one-tenth of one percent higher grade index and five-tenths of a percent less roughly ginned cotton, than did gins having no overhead cleaners. The difference in average staple length for the two groups of gins was only one-tenth of one thirty-second inch.

Should the cotton growers in the areas of Mississippi covered by this study continue to pick their cotton by hand, it seems that driers could be more profitably used than overhead cleaners. (By overhead cleaners is meant auxiliary cleaners ahead of the distributor and gin stands.) But should the trend toward mechanical harvesting of cotton continue, overhead cleaners are likely to become an essential part of the most complete ginning setup.

SUMMARY

Cotton is a raw product of the textile and other industries and consequently has to compete with other fibers that can be substituted for cotton at the point of entry into these industries. In this competitive process, the product that is of the highest quality and can be had at the lowest price will be in greatest demand.

The cotton gin plays an important part in preparing and conditioning cotton for its place in the competitive picture. This study was designed to show the influence of the type and condition of gin machinery and equipment on the cost and efficiency of operating gins as well as the grade of the ginned lint.

Complete cost and grade information was obtained from 50 gins in 4 counties in central Mississippi and 42 gins in 4 counties in north Mississippi. On the basis of detailed appraisal information, all gins were grouped according to whether they were modern, average, or sub-standard in the type and condition of gin machinery and equipment.

The 92 gins handled a total of 122,647 bales during the 1944 season, or an average of 1,333 bales per gin. The 23 modern gins had an average volume of 1,926 bales per gin as compared to an average of 960 for the 30 sub-standard gins. The average age of the modern gins was 8 years as compared to an average of 18 years for the sub-standard group. The estimated replacement value of the 92 gins is slightly under 2 million dollars or an average of $21,703 per gin. The present value, however, averaged only $11,948 or 55 percent of the replacement value.

After allowing for all current expenses, salary for management, depreciation, and interest on the investment, the average gin in 1944 returned a net profit of $491 on the ginning operation. For the modern gins the profit was $1,227 and for the sub-standard group the average was only $7.00. In addition, all ginners had the profit from the handling of cottonseed and bagging and ties which amounted to an average of $1,893 and $317 respectively. When all items were included, the modern gins had a total net profit of $4,327 and the sub-standard gins a profit of $1,497.

The average cost of ginning a bale of cotton was $3.10. The average gin income was $3.46 per bale, thus leaving a net profit of $0.36 per bale. The net profit from the handling of seed and bagging and ties increased the average total net profit to $1.96 per bale for the 1944 season. The range in total net profit was from an average of $2.25 per bale for modern gins to $1.46 per bale for sub-standard gins.

It required an average of 2.9 hours of man labor to gin each bale of cotton. The 40 gins that used Diesel engines as a source of power used an average of 1.6 gallons of Diesel fuel per bale. Electrically powered gins used 19 kilowatt hours of electricity for each bale. Ten other fuel burners used 3.3 gallons of tractor fuel or fuel oil per bale while 9 gasoline powered gins used 3.1 gallons of gasoline for each bale.

The major factors that influenced ginning income were size and volume, use of labor and power, and the use of capital. All sizes of gins that had large volumes and made efficient use of their labor, power, and capital returned a reasonable net profit. As usual, efficient large gins with a large volume returned a larger profit than smaller gins. To insure enough income to at least break even, small 2-stand gins needed about 500 bales per gin stand, 3-stand gins at least 450 bales per stand and 4-stand gins at least 400 bales per stand. However, this volume alone did not insure the financial success of every individual gin, but volume plus the efficient use of labor, power and capital, almost always insured the financial success of the ginning operation.

Cotton driers have a decided effect on ginning preparation. Those gins using driers had 3.7 percent rough preparation as compared with 6.8 percent rough preparation for gins not having driers.

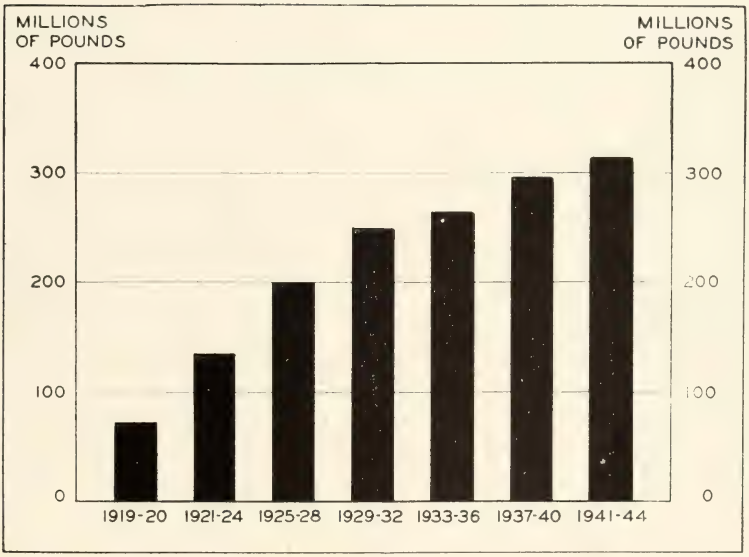
Little difference existed in the density of seed rolls maintained by the various groups of gins. However, those gins using tight seed rolls were all in the average and sub-standard groups. Modern gins maintained considerably higher saw speeds than did either the average or sub-standard groups. Saws and ribs on the modern gins were in good to fair condition, while several of the average and sub-standard gins had saws and ribs in poor condition.

Gins built during the period, 1937 to 1944, had 4.9 of their samples reduced one or more grades. But, gins built prior to 1937 had 7.2 percent of their samples reduced one or more grades because of rough ginning. Age of gin, therefore, seems to have had considerable influence on the quality of cotton turned out.

The average value of lint turned out by gins having both saws and ribs in good condition was 22.22 cents per pound. That turned out by gins having either or both saws and ribs in fair to poor condition had an average of 22.13 cents per pound.

BULLETIN 422 July 1945

Development of the
DAIRY INDUSTRY
in Mississippi



Pounds of milk or its equivalent purchased annually by plants manufacturing dairy products in Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, DIRECTOR
STATE COLLEGE MISSISSIPPI

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ACKNOWLEDGMENT

This is the first of a series of studies designed to provide a general picture of dairying in Mississippi, to point out problems in milk production and processing, and to provide factual information that should aid in the solution of these problems.

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Development of the Dairy Industry in Mississippi

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Over a long period of years, agricultural leaders of Mississippi have emphasized the need for increasing dairying within the State. This emphasis has been based partially on certain natural advantages and partially on the danger of placing too much emphasis on cotton as the almost exclusive cash crop in most sections of the State. The prospective unfavorable post-war outlook for cotton gives added emphasis to the need for re-examining and re-emphasizing the possibility of and need for expanding dairy production in those areas that have natural advantages in milk production.

This study is designed to give perspective to the possibility of expanding dairy production in Mississippi. No attempt was made to derive or work out possible solutions for problems confronting the dairy industry; however, data have been provided that should point the way to the solution of these problems by trained dairy production and marketing men.

Source of Data

The Mississippi Department of Agriculture and Commerce has on file annual reports of all dairy plants since 1929 and annual reports of manufacturing plants only, since 1919. These individual plant reports give the amount of milk and butterfat purchased from producers and the kind and amount of dairy products manufactured. The greater part of the data used in this study were obtained from these reports.

The annual reports filed at Jackson do not give the complete picture of commercial dairying in Mississippi, because all dairymen who retail their own milk and some of the smaller fluid milk plants do not file reports. In addition, the milk picked up on milk routes and hauled to fluid milk plants outside the

State does not appear in these reports. This means, of course, that fluid milk sales appear less important than they really are; however, for purposes of this report, this is not a limiting factor because this study is concerned primarily with the dairy manufacturing industry.

The number of manufacturing plants in operation and the amount of dairy products manufactured each year prior to 1919, as well as the date of opening of the early manufacturing plants, were obtained from the annual reports of the Dairy Specialist of the Mississippi Extension Service. Additional information was obtained from manufacturing plants, the United States Census, and various divisions of the U. S. Department of Agriculture.

Definition of Terms

Manufacturing plants: creameries, cheese plants, condenseries, and concentrated by-products plants. All plants manufacturing butter, cheese, and condensed milk were counted as separate plants even though they were operated in the same building in a few instances. Concentrated by-products plants were not considered as separate plants unless the by-products manufactured made up a predominate part of all products manufactured.

Dairy plants: manufacturing plants plus fluid milk and ice cream plants.

Butterfat manufactured: butterfat manufactured into butter, cheese, and condensed milk.

Condensery: plants producing condensed or evaporated whole milk. Condensed milk is the term used to designate both condensed and evaporated whole milk.

Fluid milk: includes milk and sweet cream sold for direct consumption.

DAIRY FARMING IN MISSISSIPPI

Dairying as a major farm enterprise is relatively undeveloped in Mississippi as compared to some of the more concentrated dairy areas of the United States. For example, Mississippi has less than one-half as many milk cows per square mile as the middle Atlantic and the east north central states;

milk produced per farm amounts to only about one-fifth that of the above states; and only about one-third the milk produced in Mississippi is sold as whole milk or cream, as compared to more than eight-tenths of the milk produced in the states mentioned above. See table 1.

From 1899 to 1939, Mississippi's relative position in the production of milk in the United States remained about the same. In 1899, Mississippi ranked 23rd among the 48 states in the amount of milk produced, and produced 1.34 percent of all the milk in the United States; by 1939, Mississippi ranked 24th in milk production and produced 1.31 percent of all milk produced, a slight deterioration of position on both counts. However, as far as milk sales are concerned, Mississippi's relative position has improved considerably. In 1939, Mississippi ranked 25th in the amount of milk sold, and sold 0.73 percent of all the milk sold in the United States, as compared to a rank of 41 in the amount of milk sold and 0.10 percent of total United States milk sales in 1899. See table 2.

With regard to their relative contributions to farm income, dairy products have doubled in importance in Mississippi since the middle twenties. The proportion of cash farm income, excluding government payments, that comes from the sale of dairy products increased from 3.3 percent for the period 1924-28 to 7.4 percent for the period 1937-39, then decreased slightly to 6.0 percent for the period 1942-44.

Table 1. Dairying in Mississippi compared with other sections of the United States, 1939

Area	Milk cows per square mile	Milk produced per cow milked	Milk produced per farm reporting cows milked	Percent of milk produced that is sold as milk and cream
	Number	*Pounds*	*Pounds*	*Percent*
United States	7.4	4,515	21,224	75.7
New England	11.1	5,246	41,607	84.5
Middle Atlantic	21.9	5,607	48,564	88.1
East North Central	22.5	5,022	33,041	87.5
West North Central	11.2	4,145	25,293	80.5
South Atlantic	6.0	3,767	8,729	40.4
East South Central	10.0	3,285	7,680	37.0
West South Central	5.7	3,414	11,060	46.9
Mountain	0.9	5,040	24,252	72.3
Pacific	3.6	6,244	46,380	85.9
Mississippi	9.6	2,838	6,742	30.6

Source: United States Census, 1940.

Table 2. Mississippi's rank among the 48 states in milk produced and sold, and the percent Mississippi's milk production and sales are of the United States total, 1899-1939

Year	Milk produced		Milk sold	
	Mississippi's rank among the 48 states	Percent of total United States production	Mississippi's rank among the 48 states	Percent of total United States sales
1899	23	1.34	41	0.10
1909	26	1.29	42	0.10
1919	27	1.13	41	0.16
1924	29	.97	38	0.27
1929	24	1.18	30	0.64
1934	22	1.31	(1)	(1)
1939	24	1.31	25	0.73

Source: United States Census, 1900-1940.
(1) Data not available.

The number of milk cows and heifers, 2 years old and over, on farms as of January 1 decreased each year from 475,000 in 1920 to 408,000 in 1927, then increased each year to 595,000 head in 1935. This is an increase of 120,000 head or 26 percent over 1920. After 1935, the number on farms declined each year until 1941 when 525,000 head were reported. Under the impetus of the war the number of milk cows and heifers on farms increased rapidly to 591,000 in 1944, only slightly less than the peak of 595,000 head in 1935. See table 3.

In 1939, 34.1 percent of the farms in Mississippi reported no milk cows; 60.3 percent reported from 1 to 4 milk cows, and only 5.6 percent reported 5 or more milk cows. This last group of farms had 34.5 percent of milk cows in Mississippi and produced 36.5 percent of all milk in the State. From a commercial standpoint this group is even more important because they sold 86.5 percent of milk and 72.6 percent of the cream marketed in the State. Thus it would appear that only

Table 3. Milk cows and heifers, 2 years old and over, on farms, Mississippi, 1920-1944

Year	Milk cows and heifers *thous.*	Year	Milk cows and heifers *thous.*	Year	Milk cows and heifers *thous.*	Year	Milk cows and heifers *thous.*	Year	Milk cows and heifers *thous.*
1920	475	1925	425	1930	440	1935	595	1940	541
1921	451	1926	412	1931	468	1936	553	1941	525
1922	446	1927	408	1932	510	1937	547	1942	551
1923	437	1928	412	1933	550	1938	547	1943	579
1924	433	1929	425	1934	581	1939	547	1944	591

Source: Livestock, Meats and Wool Market Statistics and Related Data, 1941, AMA, USDA, 1942; and reports of the BAE, 1943-1944.

Table 4. Number of cows milked and the proportion of milk produced and dairy products sold by farms reporting different size herds, Mississippi, 1939

Cows milked	Percent of farms	Percent of all cows milked	Percent of all milk produced	Percent of all whole milk sold	Percent of all cream sold
None	34.1	----	----	----	----
1 - 4	60.3	65.5	63.5	13.5	27.4
5 and above	5.6	34.5	36.5	86.5	72.6
State	100.0	100.0	100.0	100.0	100.0

Source: United States Census, 1940.

about one farm out of eighteen is of much importance as far as commercial dairy production is concerned. See table 4.

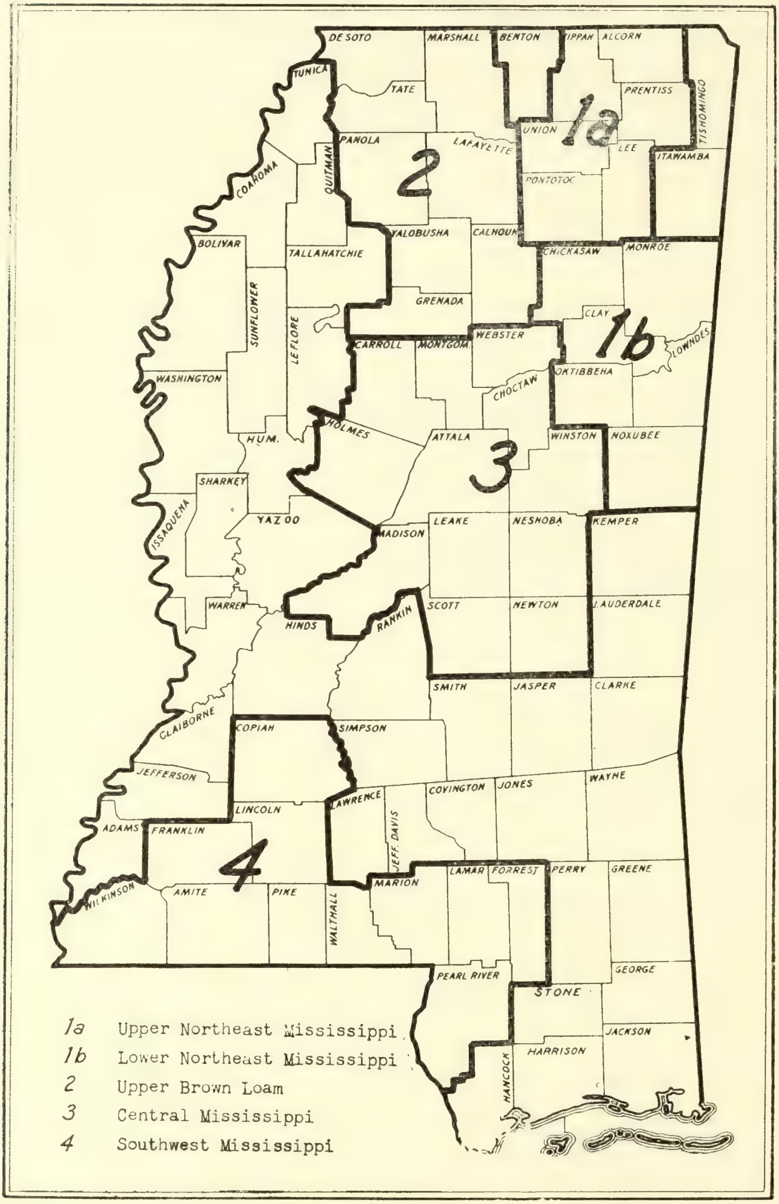
Although dairying is relatively undeveloped for the State as a whole, there are certain areas within the State where dairying has been developed to a considerable extent. In 1939 there were 20.2 milk cows per square mile in the lower Northeast Mississippi Milkshed Area and 18.1 milk cows per square mile in the Upper Northeast Mississippi Milkshed Area. See table 5. These figures compare rather favorably with the 21.9 and 22.5 milk cows per square mile in the Middle Atlantic and East North Central States, which are the most concentrated dairy states in the nation. Cows milked per square mile in the other important milkshed areas are as follows: 13.1 in the Upper Brown Loam; 10.8 in Central Mississippi, and 8.4 in Southwest Mississippi. See figure 1 for the location of the various milkshed areas.

As shown above, the greater part of the milk and cream sold in Mississippi is produced on farms with five or more cows. A breakdown of the size of herds by areas shows that the

Table 5. Cows milked per square mile and the percent of farms having specified numbers of cows, by areas, Mississippi, 1939

Milkshed area	Cows milked per square mile	Percent of farms having		
		No cows	1 - 4 cows	5 cows and above
Upper Northeast Mississippi	18.1	12.7	75.7	11.6
Lower Northeast Mississippi	20.2	25.6	57.5	16.9
Upper Brown Loam	13.1	30.4	62.8	6.8
Central Mississippi	10.8	23.5	70.4	6.1
Southwest Mississippi	8.4	26.7	66.1	7.2
Other areas	6.2	45.4	52.5	2.1
Mississippi	9.6	34.1	60.3	5.6

Source: United States Census.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PEARL RIVER
GEORGE
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HARRISON
HANCOCK
1a Upper Northeast Mississippi
1b Lower Northeast Mississippi
2 Upper Brown Loam
3 Central Mississippi
4 Southwest Mississippi

Figure 1. Important milkshed areas, Mississippi, 1944.

herds with five cows or more are concentrated in the Upper and Lower Northeast Mississippi Milkshed Areas to a greater extent than in any of the other areas. See table 5. The Upper Northeast Mississippi Milkshed Area has the smallest percentage of farms with no cows, 12.7 percent as compared to from 23.5 to 30.4 percent for the other milkshed areas.

HISTORICAL DEVELOPMENT OF DAIRY MANUFACTURING PLANTS[1]

Commercial dairy production, other than small amounts of fluid milk around towns, did not get started in Mississippi until after the boll weevil came in and played havoc with cotton production for several years. The boll weevil infestation began to get serious about 1908 or 1909, and within a few years farmers were looking for other sources of income to supplement their decreased cotton income. It was during this period that the dairy industry began to develop in Mississippi.

There is some doubt as to which of two creameries should be accorded the distinction of being the first dairy manufacturing plant in the State. A cooperative creamery was organized at Brookhaven in 1909 but closed soon after. This plant was reopened for business in May 1913 by private management, but, in the meantime, the A & M Cooperative Creamery at A & M College, Starkville, Mississippi, had been opened for business in September 1912. It would be correct and probably satisfactory to all concerned to say that the first creamery was established at Brookhaven but that the first creamery to continue operation was established at State College.

The location of other early creameries and the date each started operation is as follows: Macon, July 1913; Meridian, October 1, 1914; West, October 16, 1914; Jackson, November, 1914; Okolona, 1914 or 1915; Aberdeen, and a second creamery at Brookhaven, 1915; and McComb, Sumrall, Tupelo, Water Valley, Durant, and Lexington, 1916. By 1919, 24 creameries were in operation and the number in operation remained at about this level until 1926 when the first condensery was opened at Starkville. The condensery at Starkville was soon followed by condenseries at Tupelo in 1927 and at Macon and Kosciusko in 1928.

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[1] See figures 2, 3, and 4 for shifts in the type and location of plants and figure 5 for the location of plants that have gone out of business or been replaced by plants using more of the total milk solids.

Cheese plants were the last of the three major types of dairy manufacturing plants to begin operating in Mississippi. The first cheese plant in Mississippi of which record is available was opened at Yazoo City in July 1927; however, an inadequate volume of milk was available and this plant was forced to close soon after opening. Kraft Cheese Company opened plants at Durant and Louisville in September and November of 1927. Cheese plants were opened at Billups, Montrose, Houston, Philadelphia, Columbus, Winona, Water Valley, Olive Branch, Indianola, West, Aberdeen, and McComb, in 1928. The cheese plants in the last three towns were opened in connection with creameries that were already operating. Most of the early cheese plants had difficulty in securing volume enough to operate at a profit; 7 of the first 15 cheese plants to open for business were closed in less than a year and only 3 are still operating today. In addition, a cheese plant was re-established in one of the above towns a few years after the original plant closed.

The number of plants manufacturing dairy products increased from 26 in 1926 to 39 in 1928 as a result of the establishment of cheese plants and condenseries. The number of manufacturing plants reached a peak in 1932 and 1933 when 45 plants were in operation. Since that time, the number in operation has declined until there were only 29 operating in 1943 and 31 in 1944. The decline in the number of creameries accounts for most of the decrease in plants during this period. As will be shown later in the section on prices, creameries cannot pay as much per pound of butterfat in cream as cheese plants and condenseries can pay for butterfat in milk. This has resulted in creameries going out of business in most areas where they were in direct competition with cheese plants or condenseries. Figures 4 and 5 show cheese plants or condenseries now operating in towns or counties where creameries have gone out of business. See Appendix table 1 for the number and type of plants in operation by years.

BUTTERFAT PURCHASED FROM PRODUCERS[2]

The amount of butterfat purchased by dairy manufacturing plants has increased, period by period, since the first plant was

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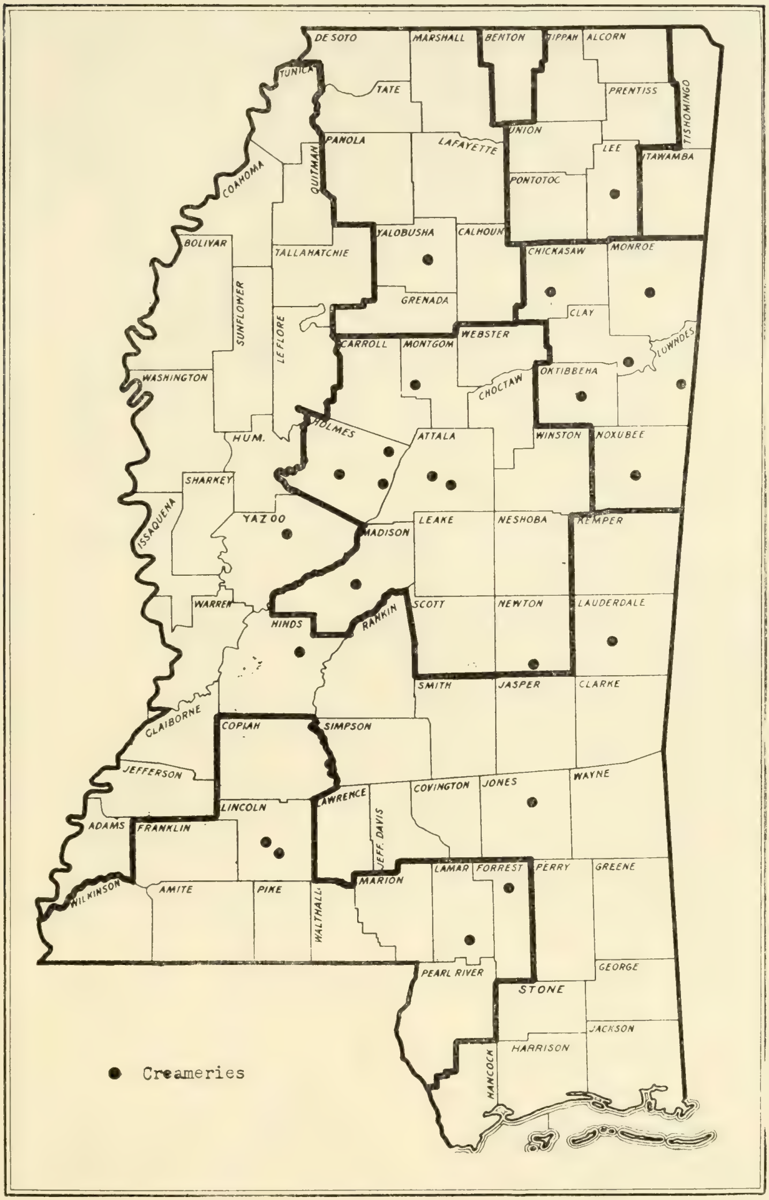
[2] The amount of butterfat purchased from producers has been converted to pounds of milk equivalent for the benefit of those who are more interested in whole milk than butterfat. See column 5 of tables 6 and 7. However, the result will be essentially the same, regardless of which measure of volume is used in discussing the trend in purchases. Tables 2 and 3 in the Appendix give the purchases of butterfat or milk equivalent by years.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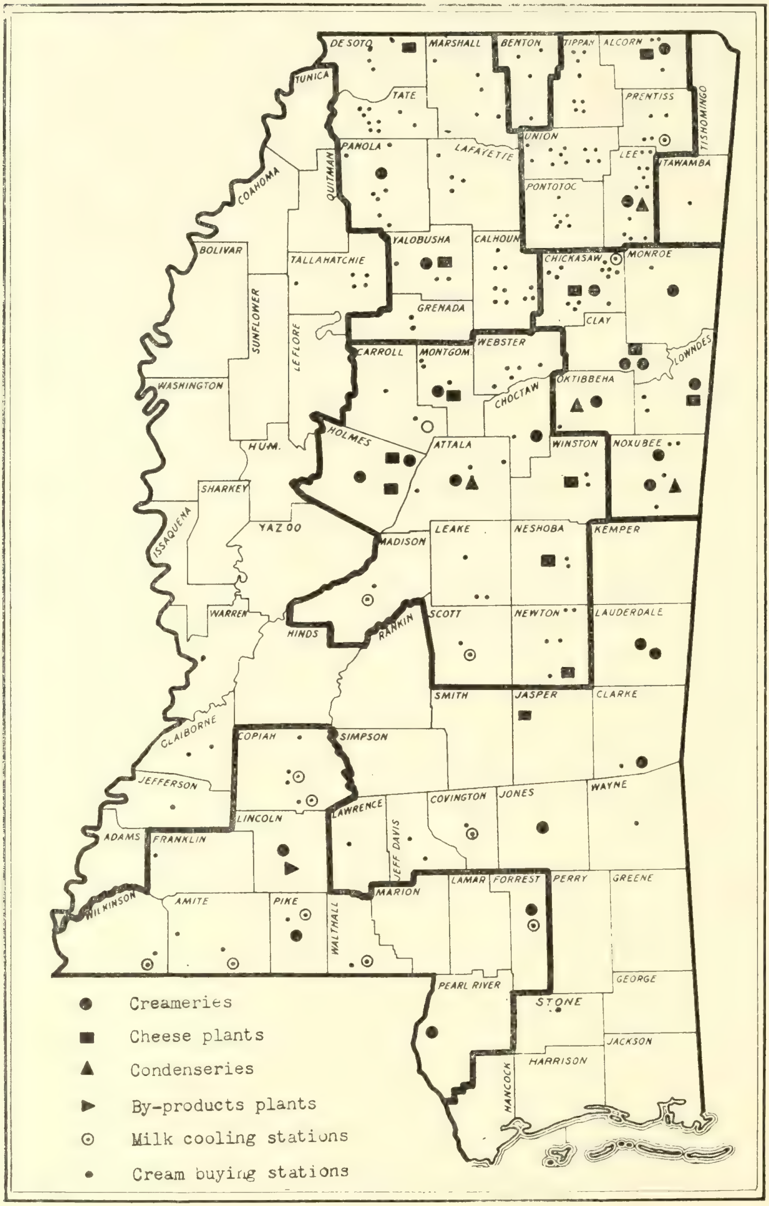
● Creameries

Figure 2. Location of plants manufacturing dairy products, Mississippi, 1919.

(Note: Four cream buying stations and four milk cooling stations were operating in 1919, but their locations are not available.)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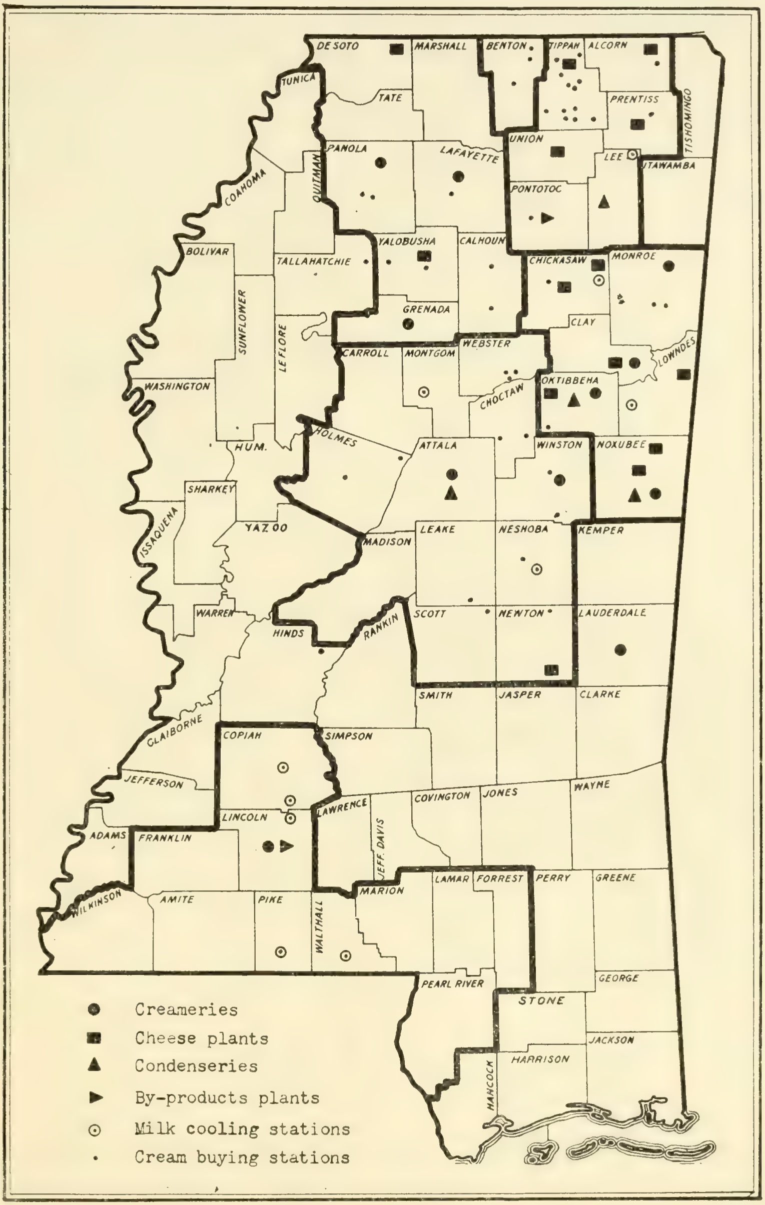
● Creameries
■ Cheese plants
▲ Condenseries
▶ By-products plants
⊙ Milk cooling stations
• Cream buying stations

Figure 3. Location of plants manufacturing dairy products, and cooling and cream buying stations, Mississippi, 1929.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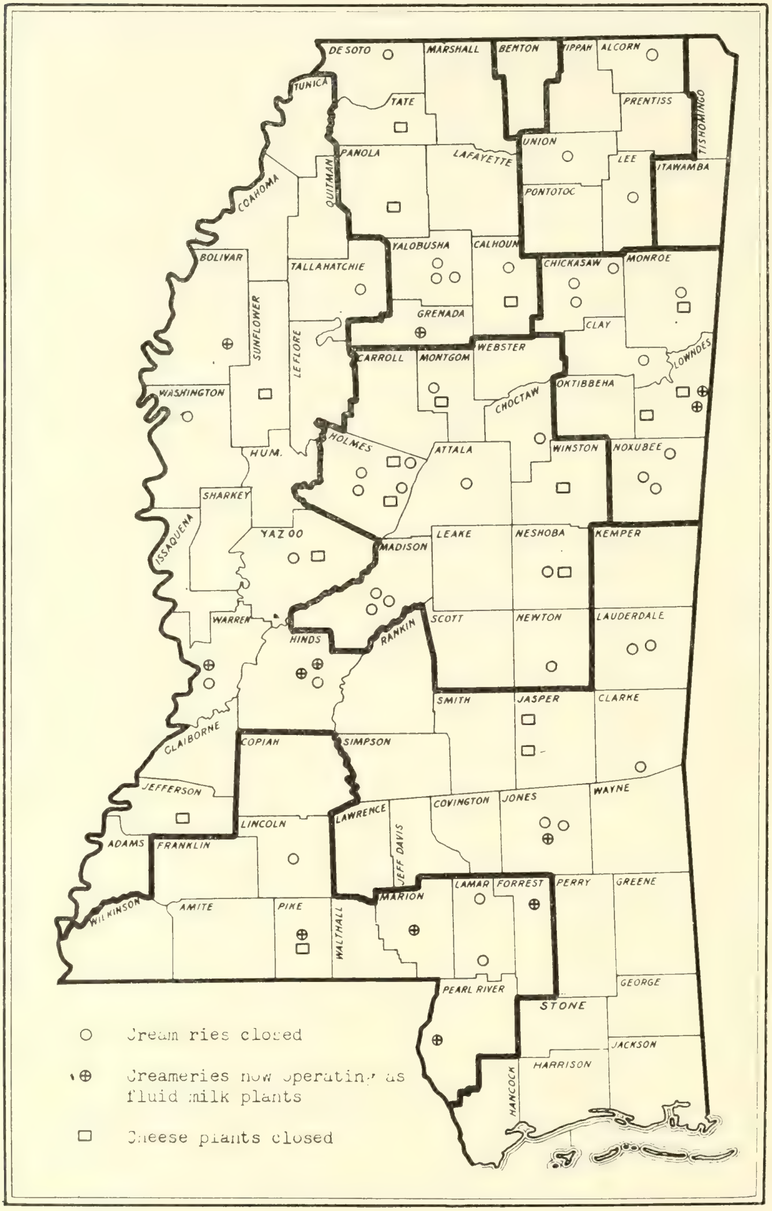
● Creameries
■ Cheese plants
▲ Condenseries
▶ By-products plants
⊙ Milk cooling stations
• Cream buying stations

Figure 4. Location of plants manufacturing dairy products, and cooling and cream buying stations, Mississippi, 1944.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HANCOCK
○ Creameries closed
⊕ Creameries now operating as fluid milk plants
☐ Cheese plants closed

Figure 5. Location of plants that have discontinued the manufacture of dairy products, Mississippi, 1912-1944.

established in 1912. See table 6. The butterfat purchased from producers reached an annual average of 3,096,000 pounds in the 2-year period 1919-20, and increased rapidly thereafter to an average of 11,172,000 pounds in the 4 years ending with 1932. After 1932, purchases continued to increase, though at a slower rate, to 13,997,000 pounds per year in the period 1941-44. The amount of butterfat purchased per year increased 8,076,000 pounds between 1919-20 and 1929-32 and 2,825,000 pounds between 1929-32 and 1941-44. Thus, the absolute rate of increase was only about one-third as great after 1932.

The above figures do not, however, tell the whole story as to the increase in butterfat purchased after 1932. The amount of butterfat purchased by all dairy plants (manufacturing plants plus fluid milk and ice cream plants) increased from 12,361,000 pounds per year for the period 1929-32 to 17,359,000 pounds for the period 1941-44, an increase of 4,998,000 pounds. See table 7. In other words, the amount of butterfat purchased by all dairy plants increased 40 percent between 1929-32 and 1941-44 as compared to an increase of 25 percent for manufacturing plants. The decrease in the proportion of milk and cream going to manufacturing plants during the war period was caused by the unusually heavy demand for fluid milk and ice cream, which in turn was brought about by the establishment of army camps in Mississippi and the increase in income among the low-income families. Manufacturing plants purchased 81 percent of butterfat bought by all dairy plants during the period 1941-44 as compared to 90 percent for the period 1929-32.

Table 6. Pounds of milk and butterfat purchased by dairy manufacturing plants, Mississippi, 1919-1944

Period	Average per year					Percent of butterfat purchased in milk
	Pounds of milk purchased	Pounds of butterfat purchased in milk	Pounds of butterfat purchased in cream	Total pounds of butterfat purchased	Total pounds of milk or its equivalent purchased	
	thous.	*thous.*	*thous.*	*thous.*	*thous.*	
1919-1920	6,184	289	2,807	3,096	71,471	9.3
1921-1924	13,005	591	5,271	5,862	135,580	10.1
1925-1928	61,484	2,864	5,953	8,817	199,935	32.5
1929-1932	150,515	6,821	4,351	11,172	251,712	61.1
1933-1936	177,541	8,066	3,766	11,833	265,132	68.2
1937-1940	225,364	10,116	3,083	13,198	297,055	76.6
1941-1944	261,007	11,709	2,288	13,997	314,216	83.7

Source: Table 2, Appendix.

Table 7. Pounds of milk and butterfat purchased by all dairy plants reporting, Mississippi, 1929-1944

Period	Average per year					Percent of butterfat purchased in milk
	Pounds of milk purchased *thous.*	Pounds of butterfat purchased in milk *thous.*	Pounds of butterfat purchased in cream *thous.*	Total pounds of butterfat purchased *thous.*	Total pounds of milk or its equivalent purchased *thous.*	
1929-1932	168,103	7,663	4,698	12,361	277,348	62.0
1933-1936	198,357	9,004	4,282	13,286	297,943	67.7
1937-1940	254,976	11,480	3,348	14,828	332,836	77.4
1941-1944	328,303	14,760	2,599	17,359	388,739	85.0

Source: Table 3, Appendix.

The 40 percent increase in the amount of butterfat purchased by all dairy plants between 1929-32 and 1941-44 was the result of a 73 percent increase in the number of patrons selling butterfat and a 19 percent decrease in the amount of butterfat sold per patron. The number of patrons selling butterfat increased, period by period, from 22,603 per year for the period 1929-32 to 39,036 per year for the period 1941-44. The amount of butterfat sold per patron decreased from 574 pounds per year during the period 1929-32 to 410 pounds per year during the period 1937-40, then increased slightly to 445 pounds per year during the next 4-year period. See table 8. It is likely that the increased production per patron during 1941-44 was the result of higher prices and the heavy pressure put on farmers by the government to produce more milk.

Whole milk is becoming relatively more and more important in the manufacture of dairy products in Mississippi. The per-

Table 8. Number of patrons, butterfat sold per patron, and total pounds of butterfat purchased by dairy plants, Mississippi, 1929-1944

Period	Average per year		
	Patrons selling butterfat[1]	Pounds of butterfat sold per patron[2]	Total pounds of butterfat purchased by dairy plants *thous.*
1929-1932	22,603	547	12,361
1933-1936	26,972	493	13,286
1937-1940	36,200	410	14,828
1941-1944	39,036	445	17,359

Source: Computed from annual report of dairy plants, 1929-1944, Mississippi Department of Agriculture and Commerce; the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi; and a survey of dairy plants, 1945.

[1] Computed by dividing the pounds of butterfat sold per patron into the total pounds of butterfat purchased by dairy plants.

[2] Based on a sample of plants. The amount of milk or its equivalent purchased by the sample plants varied from 20 percent of the total for the period 1937-1940 to 34 percent of the total for the period 1941-1944.

cent of total butterfat purchased by manufacturing plants that was purchased in milk, increased from 10 percent for the period 1921-24, when butter was the only product manufactured, to 33 percent for the period 1925-28, when condenseries and cheese plants first began operating. Milk purchases more than doubled during the next 4-year period, while the amount of butterfat purchased in cream declined by 27 percent. This caused the amount of butterfat purchased in milk to jump to 61 percent of the total, almost twice the percentage for the preceding period. The amount of milk purchased continued to increase and the amount of butterfat purchased in cream continued to decrease each period until 84 percent of all butterfat purchased by manufacturing plants was purchased in whole milk during the last 4-year period. Butterfat in milk brings a price considerably higher than butterfat sold in cream and, for this reason, most farmers living on or close to milk routes sell whole milk.

BUTTERFAT MANUFACTURED

The amount of butterfat manufactured into dairy products increased in much the same manner as the amount of milk or its equivalent purchased by manufacturing plants, with the exception that the amount of butterfat manufactured from 1941 to 1944 decreased 0.8 percent as compared to the preceding 4-year period. See table 9. As already mentioned, the unusually heavy demand for fluid milk and ice cream has caused many plants to sell considerable quantities of fluid milk and sweet cream during the war period. These plants were forced to do this from a profit standpoint because butterfat can be sold for a higher profit per pound in fluid milk and sweet cream than in manufactured form.

Table 9. Pounds of butterfat manufactured, Mississippi, 1912-1944

Period	Average pounds of butterfat manufactured per year	Increase over preceding period	Percent increase over preceding period
1912-1916	418,704	......	......
1917-1920	2,450,027	2,031,323	485.2
1921-1924	5,083,920	2,633,893	107.5
1925-1928	7,048,088	1,964,168	38.6
1929-1932	9,893,541	2,845,453	40.4
1933-1936	10,350,674	457,133	4.6
1937-1940	11,121,903	771,229	7.45
1941-1944	11,031,280	— 90,623	— 0.8

Source: Table 4, Appendix.

SOLIDS NOT FAT MANUFACTURED

The amount of solids not fat utilized by dairy manufacturing plants in Mississippi was negligible until after 1926 when condenseries and cheese plants first began operating. Up to that time, most of the solids not fat in the milk from which butterfat was used in manufacturing butter were retained on farms in the form of skim milk. During the period 1929-32, the solids not fat retained on farms in the form of skim milk amounted to only 36 percent of the total in milk sold as whole milk and cream. Both the absolute and relative amount of solids not fat retained on farms have continued to decrease to the present time. Only 14 percent of the total solids not fat in milk sold as whole milk and cream was retained on farms in the form of skim milk during the period 1941-44. See table 10.

The amount of solids not fat manufactured in cheese, condensed milk, and concentrated by-products, averaged 8,066,000 pounds per year during the period 1929-32 and 15,584,000 pounds per year during the period 1941-44. This is an increase of 93 percent. The fact that the amount of butterfat manufactured only increased 11 percent during this same period further emphasizes the increasing importance of solids not fat in the manufacture of dairy products in Mississippi.

Table 10. Pounds of solids not fat manufactured, retained on farms, and total in milk sold as whole milk and cream, Mississippi, 1929-1944

Period	Average per year		
	Solids not fat manufactured *thous.*	Solids not fat retained on farms in skim milk *thous.*	Total solids not fat in milk sold as whole milk and cream *thous.*
1929-1932	8,066	8,958	24,823
1933-1936	9,955	8.166	26,666
1937-1940	13,370	6,385	29,789
1941-1944	15,584	4,956	34,792

Source: Computed from annual reports of dairy plants, Mississippi Department of Agriculture and Commerce, 1929-1944; and the annual summaries of dairy products, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

VOLUME PER PLANT MANUFACTURING DAIRY PRODUCTS

Volume per plant manufacturing dairy products has increased continuously, with one exception, since the first successful plant was established in 1912. Plants operating in the period

1929-32 had a smaller volume than the plants operating in the preceding period. See table 11. The annual volume of butterfat manufactured per plant increased from 60,000 pounds for the period 1912-16 to 226,000 pounds for the period 1929-32, and 347,000 pounds for the period 1941-44. That is, the amount of butterfat manufactured per plant increased 166,000 pounds or 276 percent between 1912-16 and 1929-32, and 121,000 pounds or 54 percent between 1929-32 and 1941-44. When the amount of butterfat purchased from producers is considered, volume per plant has increased even more since 1932. The amount of butterfat purchased from producers per plant increased from 255,000 pounds per year for the period 1929-32 to 441,000 pounds for the period 1941-44, an increase of 186,000 pounds or 73 percent.

Although the number of plants manufacturing dairy products decreased 27 percent between 1929-32 and 1941-44, the volume of butterfat purchased per plant increased enough (73 percent) to bring about a 13 percent increase in the amount of butterfat purchased from producers. This trend toward a smaller number of plants with a larger volume will in all probability continue for sometime, because most plants in Mississippi, if not all, are operating at levels far below their most efficient volume. (See figure 8 for the relationships between capacity and volume handled at 12 plants in 1944.)

Table 11. Plants manufacturing dairy products, butterfat purchased from producers and manufactured, and the average amount of butterfat purchased and manufactured per plant, Mississippi, 1912-1944

Period	Average per year			Pounds of butterfat	
	Manufacturing plants *number*	Pounds of butterfat purchased *thous.*	Pounds of butterfat manufactured *thous.*	Purchased per plant *thous.*	Manufactured per plant *thous.*
1912-1916	7	......	419	......	60
1917-1920	23	......	2,450	......	108
1921-1924	24	5,862	5,084	242	210
1925-1928	30	8,817	7,048	291	232
1929-1932	44	11,172	9,894	255	226
1933-1936	41	11,833	10,351	287	251
1937-1940	39	13,198	11,122	343	289
1941-1944	32	13,997	11,031	441	347

Source: Appendix tables 1, 2, and 4.

DAIRY PRODUCTS MANUFACTURED

Butter

The number of creameries in operation increased rapidly from 1 in 1912 to 24 in 1919, then remained at about this level throughout the Twenties. The number of creameries reached a peak in 1932 and 1933 when 28 plants operated; since that time, the number operating has decreased until only 11 plants reported the manufacture of butter in 1944. The amount of butter manufactured reached a peak of 8,884,000 pounds in 1932, then declined to 4,491,000 pounds in 1944, about one-half as much. That is, both the number of creameries operating and the amount of butter manufactured decreased after 1932. See figure 6.

The number of creameries operating, the amount of butter manufactured, and the volume manufactured per plant was calculated by 4-year periods in order to smooth out the yearly fluctuations (caused by climatic conditions) and, consequently, to smooth out the trend in the above items. When this was done, it was found that the number of creameries and the total amount of butter manufactured increased, period by period,

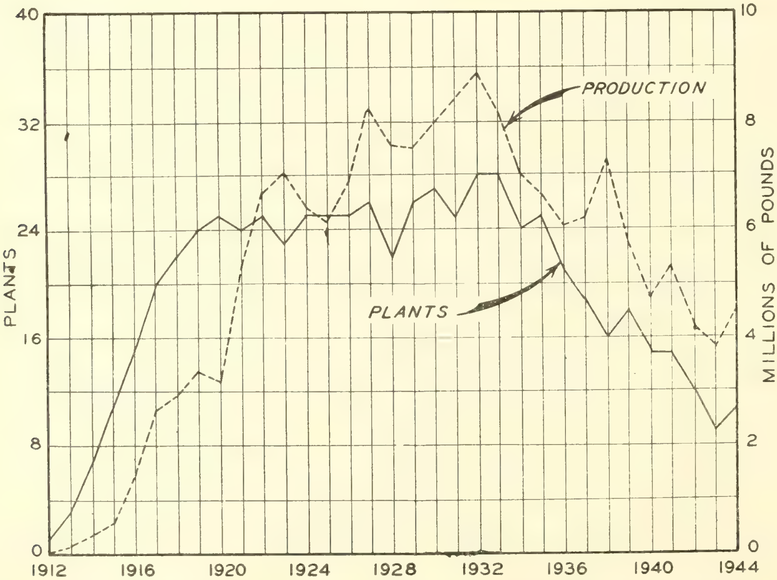

Figure 6. Number of creameries reporting and pounds of butter manufactured, Mississippi, 1912-1944.

Table 12. Number of creameries, butter manufactured, and butter manufactured per plant, by periods, Mississippi, 1912-1944

Period	Average per year		Pounds of butter manufactured per plant
	Creameries	Pounds of butter manufactured	
	number	*thousands*	*thousands*
1912-1916	7	520	74
1917-1920	23	3,030	133
1921-1924	24	6,355	262
1925-1928	25	7,209	294
1929-1932	27	7,376	278
1933-1936	25	6,961	284
1937-1940	17	6,013	354
1941-1944	12	4,454	379

Source: Tables 1 and 4 in the appendix.

through 1929-32, then decreased, period by period, thereafter. The volume manufactured per plant increased through the period 1925-28, decreased slightly the next two periods, then continued to increase to the present. See table 12. Between 1929-32 and 1941-44, the number of creameries operating decreased 56 percent, the volume manufactured per plant increased 36 percent, and total amount of butter manufactured decreased 40 percent.

Competition among creameries for butterfat became rather intense during the Twenties and this led to the indiscriminate establishment of cream buying stations throughout the important milk producing areas. During this period, practically 100 percent of the cream buying stations were company-owned and as many as five different stations were operated in the same town in some instances. The number of cream buying stations increased from 4 in 1919 to a peak of 180 in 1930, then decreased gradually to 104 in 1939. The number in operation has decreased rapidly during the war; only 46 were operated in 1944 and only 5 of these were company-owned stations.

Cheese

Cheese plants in Mississippi were established rapidly after the first three plants opened in 1927. The number of cheese plants increased to 13 the next year and the number in operation has not exceeded or fallen short of this total by more than 4 plants since that time. Fourteen plants have manufactured cheese in each of the last 4 years. The amount of cheese manufactured increased from 198,000 pounds in 1927

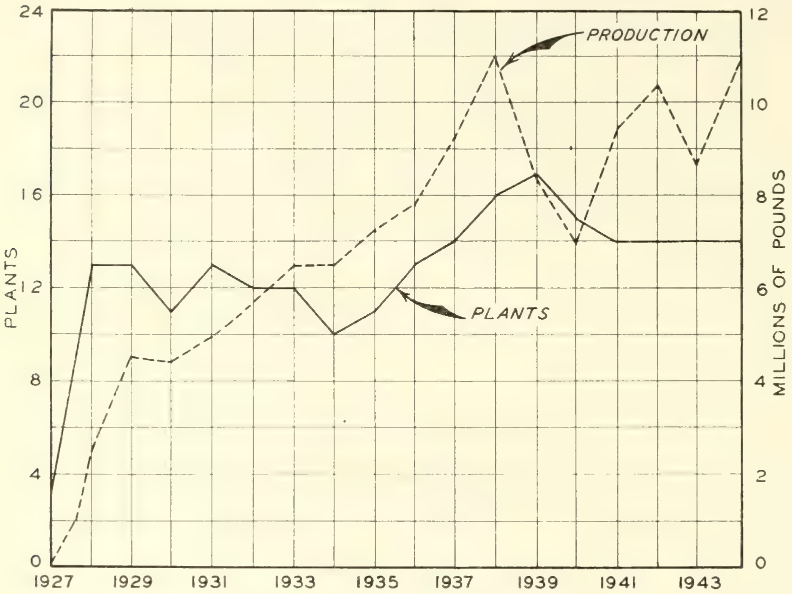

Figure 7. Number of cheese plants reporting and pounds of cheese manufactured, Mississippi, 1927-1944.

and 2,531,000 pounds in 1928 to a peak of 11,006,000 pounds in 1938. Production in 1944 amounted to 10,969,000 pounds or 0.3 percent less than in 1938. See figure 7.

Although more cheese was manufactured in 1938 than in any other year, a combination of the years into groups shows that 982,000 pounds or 11 percent more cheese was manufactured per year during the period 1941-44 than during the period 1937-40. See table 13. In fact, the amount of cheese manufactured per year has increased, period by period, since

Table 13. Number of cheese plants, cheese manufactured, and cheese manufactured per plant, by periods, Mississippi, 1927-1944

Period	Average per year		Pounds of cheese manufactured per plant
	Cheese plants	Pounds of cheese manufactured	
	number	*thousands*	*thousands*
1927-1928	8	1,364	171
1929-1932	12	4,905	400
1933-1936	12	7,013	610
1937-1940	16	8,932	576
1941-1944	14	9,914	708

Source: Tables 1 and 4 in the appendix.

cheese plants were first established. Although the number of cheese plants operating increased only slightly between 1929-32 and 1941-44, the volume manufactured per plant increased to such an extent (77 percent) that total cheese production more than doubled (an increase of 102 percent).

Condensed milk

The number of condenseries operating in Mississippi increased from one in 1926 to two in 1927 and to four in 1928, where it has since remained. Condenseries require considerably more milk for efficient operation than cheese plants; this, no doubt, has limited their number. The amount of condensed milk manufactured increased from 17 million pounds per year for the period 1926-28 to 51 million pounds for the period 1941-44. The amount of condensed milk manufactured and, consequently, the volume per plant, almost doubled (90 percent increase) between 1929-32 and 1941-44. See table 14.

Table 14. Pounds of condensed milk manufactured by periods, Mississippi, 1926-1944

Period	Average pounds of condensed milk manufactured per year	Increase over preceding period	Percent increase over preceding period
1926-1928	16,734,957	......	....
1929-1932	26,907,947	10,172,990	60.79
1933-1936	30,240,556	3,332,609	12.39
1937-1940	42,123,787	11,883,231	39.30
1941-1944	51,114,988	8,991,201	21.34

Source: Appendix table 4.

Concentrated by-products

Concentrated by-products have become of more and more importance in the dairy industry in Mississippi. Between 1929-32 and 1941-44, the amount of condensed skimmed milk manufactured increased from 2,013,000 pounds per year to 4,686,000 pounds per year; the amount of non-fat dry milk solids increased from 602,000 pounds per year to 1,635,000 pounds per year, and the amount of dried buttermilk manufactured decreased from 396,000 pounds per year to 286,000 pounds per year. That is, two and one-third times as much condensed skimmed milk, two and three-fourths as much non-fat dry milk solids, and seven-tenths as much dried buttermilk were man-

Table 15. Pounds of concentrated by-products manufactured and pounds of skim milk in all concentrated by-products, Mississippi, 1929-1944

Period	Average per year			
	Sweetened condensed and plain condensed or evaporated skim milk *thousands*	Non-fat dry milk solids *thousands*	Dried butter-milk *thousands*	Skim milk in all concentrated by-products[1] *thousands*
1929-1932	2,013	602	396	13,784
1933-1936	1,418	1,370	339	21,133
1937-1940	2,490	1,857	299	30,141
1941-1944	4,682	1,635	286	34,834

Source: Annual reports of dairy plants, 1929-1944, Mississippi Department of Agriculture and Commerce, and the annual summaries of Dairy Production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

[1] Computed.

ufactured in the period 1941-44 as in the period 1929-32. The amount of skimmed milk manufactured into concentrated by-products amounted to 35 million pounds per year for the period 1941-44, two and one-half times the 14 million pounds manufactured per year for the period 1929-32. See table 15.

FLUID MILK SALES AND ICE CREAM PRODUCED

Fluid milk sales remained at approximately the same level from the period 1929-32 through the period 1937-40, then almost tripled the next 4-year period. The amount of fluid milk or its equivalent sold per year increased from 29 million pounds for the period 1937-40 to 81 million pounds for the period 1941-44. The number of plants selling fluid milk increased from 24 to 31 during the same period. See table 16.

Table 16. Number of ice cream plants, gallons of ice cream made, plants selling fluid milk for direct consumption, and pounds of milk or its equivalent sold as fluid milk or sweet cream for direct consumption, Mississippi, 1929-1944

Period	Average per year			
	Plants manufacturing ice cream mix *number*	Gallons of ice cream manufactured *thousand*	Plants selling fluid milk for direct consumption *number*	Pounds of milk or its equivalent sold as fluid and sweet cream for direct consumption[1] *thousand*
1929-1932	35	959	27	27,511
1933-1936	31	1,038	28	28,005
1937-1940	27	1,319	24	28,986
1941-1944	24	2,751	31	81,054

Source: Annual reports of dairy plants, 1929-1944, Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

[1] Computed as milk with 4.5 percent butterfat. Includes fluid milk shipped to plants in other states by plants in Mississippi.

The amount of ice cream manufactured increased slowly from 959,000 gallons per year for the period 1929-32 to 1,319,000 gallons per year for the period 1937-40. The amount of ice cream manufactured jumped to 2,751,000 gallons per year for the period 1941-44, an increase of over 100 percent. No attempt was made to tabulate the increase in the number of establishments manufacturing (or freezing) ice cream because of the tremendous increase in counter freezers during the past few years. However, the number of plants manufacturing ice cream mix decreased from 35 per year for the period 1929-32 to 24 per year for the period 1941-44.

The tremendous increase in fluid milk and ice cream sales during the period 1941-44 was the direct result of the war which caused army camps to be located in Mississippi and the income of low-income families to increase. It is likely that fluid milk and ice cream sales in Mississippi will return to approximately their pre-war levels after the war, unless the income of the people of Mississippi, especially low income groups can be maintained at levels considerably higher than in pre-war years.

RELATIVE IMPORTANCE OF DAIRY PRODUCTS

Butter, condensed milk, and cheese, in the order named, were the most important dairy products manufactured in Mississippi between 1929 and 1932. Since that time, butter has declined in volume and condensed milk and cheese increased until both condensed milk and cheese rank ahead of butter in importance, with condensed milk ranking first. In arriving at the relative importance of the various dairy products, the solids not fat manufactured into each product were taken into consideration as well as the butterfat util-

Table 17. Percentage of total butterfat purchased from producers that was used in various dairy products, by periods, Mississippi, 1929-1944

Period	Butter	Condensed milk	Cheese	Fluid milk	Ice cream	Other uses	Total
1929-1932	48.25	17.57	14.22	10.02	4.16	5.79	100.00
1933-1936	42.14	18.40	17.37	9.49	5.53	7.08	100.00
1937-1940	32.56	23.05	19.39	8.80	6.91	9.28	100.00
1941-1944	20.59	23.71	19.25	21.01	9.78	5.66	100.00

Source: Annual reports of dairy plants, 1929-1941, Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

Table 18. Percentage of total solids not fat in milk sold as whole milk and cream that is used in various dairy products, Mississippi, 1929-1944

Period	Cheese	Condensed milk	Ice cream	Fluid milk	Concentrated by-products	Retained on farms in skimmed milk	Other uses or waste	Total
1929-1932	5.92	20.38	1.97	9.92	6.18	36.09	19.54	100.00
1933-1936	7.89	21.64	1.98	9.40	7.80	30.62	20.67	100.00
1937-1940	9.00	26.55	2.26	8.71	9.34	21.43	22.71	100.00
1941-1944	8.55	27.27	4.03	20.85	8.97	14.24	16.09	100.00

Source: Computed from annual reports of dairy plants, 1929-1941, Mississippi Department of Agriculture and Commerce, and the annual summaries of dairy production, 1938-1940, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

ized. See table 17 and 18. Concentrated by-products and ice cream were also relatively more important between 1941 and 1944 than between 1929 and 1932.

Between 1929-32 and 1937-40, fluid milk sales became relatively less important; however, under the impetus of the war, fluid milk sales increased greatly. Fluid milk sales ranked below butter, condensed milk, and cheese in importance between 1929 and 1932, but only slightly below condensed milk between 1941 and 1944. If fluid milk sales not reported[3] were taken into account, fluid milk sales would probably rank first in importance during the war period, 1941-44. However, after the war, fluid milk sales will likely decline to some extent.

DEVELOPMENT BY AREAS[4]

Plants manufacturing dairy products have become more and more concentrated in the Northeast Mississippi Milkshed Area. Seven dairy manufacturing plants out of the 24 in Mississippi were operating in the Northeast Mississippi Milkshed Area in 1919; 17 out of 44 in 1929, and 19 out of 31 in 1944. That is, 61 percent of the plants manufacturing dairy products were located in this Area in 1944, as compared to 38 percent in 1929 and 29 percent in 1919. Thirteen creameries and three cheese plants have gone out of business in this Area; however, cheese plants or condenseries are operating in all towns where creameries have gone out of business. At least one manufacturing plant is located in each county of this Area.

On the basis of the amount of butterfat purchased from

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[3] Some of the smaller fluid milk plants and all of the many dairymen who retail their own milk do not file reports as to production and sales.

[4] See figure 2, 3, and 4 for shifts in the type and location of plants, and figure 5 for the location of plants that have gone out of business or been replaced by plants using more of the total milk solids. Tables 5 and 6 in the Appendix give the amount of butterfat purchased in each area by years.

Table 19. Pounds of butterfat purchased from producers by plants manufacturing dairy products, by areas, Mississippi, 1916-1944

Period	Milkshed Area						Other areas	State
	Lower N. E. Mississippi	Upper N. E. Mississippi	N. E. Mississippi	Upper Brown Loam	Central Mississippi	S. W. Mississippi		
	thous.	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*
1916-1920	971	67	1,038	55	527	492	414	2,526
1921-1924	2,360	324	2,684	287	1,014	948	928	5,861
1925-1928	3,408	870	4,278	445	1,001	1,264	1,829	8,817
1929-1932	4,537	1,324	5,861	898	1,819	1,243	1,351	11,172
1933-1936	5,140	1,996	7,136	942	1,515	931	1,309	11,833
1937-1940	6,058	2,955	9,013	1,151	1,521	744	769	13,198
1941-1944	6,028	3,923	9,951	822	1,750	580	894	13,997

Source: Appendix table 5.

producers, this Area has become even more important in the dairy manufacturing industry in Mississippi. The amount of butterfat purchased from producers has increased both absolutely and relatively, period by period, to the present time. See tables 19 and 20. Manufacturing plants in this Area purchased 71 percent of the butterfat purchased by all manufacturing plants in Mississippi for the period 1941-44, as compared to 53 percent for the period 1929-32, and 41 percent for the period 1916-20.

Although the Northeast Mississippi Milkshed Area is a continuous area, the development in the upper and lower parts has been quite different. The lower part of the Area developed earlier and at a more rapid rate than the upper part of the Area through the period 1929-32, whereas, the upper part of the Area has developed at a faster rate since that time. The number of manufacturing plants operating in the lower part of the Area increased from 6 in 1919 to 13 in 1929, and 13 in 1944; the number operating in the upper part of the Area increased from 1 in 1919 to 4 in 1929, and 6 in 1944. The amount of butterfat purchased from producers per year by manufacturing plants increased 1,257,000 pounds in the upper and 3,566,000 pounds in the lower part of the Area between 1916-20 and 1929-32; between 1929-32 and 1941-44, the amount of butterfat purchased from producers per year increased 2,599,000 pounds in the upper and 1,491,000 pounds in the lower part of the Area. In other words, the lower part of the Area developed about three times as fast as the upper part through the period 1929-32, but only about one-half as fast after that time.

The upper part of the Northeast Mississippi Milkshed Area has increased its relative importance, period by period, from

Table 20. Percentage of total butterfat purchased from producers by plants manufacturing dairy products that was purchased in each important milkshed area, Mississippi, 1916-1944

Period	Milkshed area						Other areas	State
	Lower N. E. Mississippi	Upper N. E. Mississippi	N. E. Mississippi	Upper Brown Loam	Central Mississippi	S. W. Mississippi		
1916-1920	38.4	2.7	41.1	2.2	20.8	19.5	16.4	100.0
1921-1924	40.3	5.5	45.8	4.9	17.3	16.2	15.8	100.0
1925-1928	38.6	9.9	48.5	5.1	11.4	14.3	20.7	100.0
1929-1932	40.6	11.9	52.5	8.0	16.3	11.1	12.1	100.0
1933-1936	43.4	16.9	60.3	8.0	12.8	7.9	11.0	100.0
1937-1940	45.9	22.4	68.3	8.7	11.5	5.7	5.8	100.0
1941-1944	43.2	28.1	71.3	5.7	12.5	4.1	6.4	100.0

Source: Table 19.

3 percent of the total butterfat purchased by manufacturing plants for the period 1916-20 to 28 percent for the period 1941-44. In contrast, the lower part of the Area has been able to increase its relative position only slightly, from 38 percent of the total for the period 1916-20 to 43 percent of the total for the period 1941-44.

The number of manufacturing plants in the Upper Brown Loam Area increased from one in 1919 to four in 1929, and five in 1944. Six creameries and three cheese plants have gone out of business in this Area. Manufacturing plants that have gone out of business in three counties of this Area have not been replaced. The amount of butterfat purchased from producers per year increased from 55,000 pounds for the period 1916-20 to 1,151,000 pounds for the period 1937-40, and then decreased to 822,000 pounds for the period 1941-44. The decrease in the amount of butterfat purchased by manufacturing plants in this Area during the war period is probably the result of more milk being trucked into Memphis to satisfy the increased demand of its wartime population for fluid milk.

The Upper Brown Loam Area increased in relative importance in the manufacture of dairy products up through the period 1937-40, then decreased to some extent during the next 4-year period. Manufacturing plants in this Area purchased 2 percent of the butterfat purchased by Mississippi manufacturing plants during the period 1916-20, 9 percent during the period 1937-41, and 6 percent during the period 1941-44.

It is likely that the amount of butterfat purchased by manufacturing plants in this Area will resume its upward trends after the war. This will be true if the demand for fluid milk should fall off in this Area and the milk thus released returned to manufacturing plants.

The number of plants manufacturing dairy products in the Central Mississippi Milkshed Area increased from 8 in 1919 to 12 in 1929, then decreased to 4 by 1944. That is, one-third of the plants manufacturing dairy products in Mississippi were operating in this Area in 1919 as contrasted to about one-fourth in 1929 and one-eighth in 1944. Twelve creameries and five cheese plants have discontinued operating in this area. Manufacturing plants that have gone out of business in five counties have not been replaced; however, milk cooling stations are operated in two of these counties.

The dairy industry got an early start in the Central Mississippi Area, but failed to develop as rapidly and to as great an extent as the State as a whole. In fact, this Area reached its peak production during the period 1929-32. The amount of butterfat purchased by manufacturing plants increased from 527,000 pounds per year for the period 1916-20 to 1,819,000 pounds for the period 1929-32, then decreased to 1,750,000 pounds for the period 1941-44. Relatively speaking, this Area has declined in importance since the period 1916-20. Plants in this Area purchased 21 percent of all butterfat purchased by manufacturing plants in Mississippi during the period 1916-20; by the time this Area had reached its peak production during the period 1929-32, this percentage had declined to 16. Only 13 percent of all butterfat purchased by manufacturing plants in Mississippi was purchased by plants in the Area during the period 1941-44.

Four plants manufactured dairy products in the Southwest Mississippi Milkshed Area in 1919, five in 1929, and two in 1944. Eight creameries and one cheese plant have discontinued manufacturing dairy products. Plants manufacturing dairy products that have gone out of business in six counties have not been replaced with manufacturing plants; however, fluid milk plants and milk cooling stations which supply fluid milk to New Orleans, army camps, and local towns are operating in four of these counties.

The amount of butterfat purchased from producers by manufacturing plants increased from 492,000 pounds per year for the period 1916-20 to 1,264,000 pounds per year for the period

1925-28, then decreased to 580,000 pounds per year for the period 1941-44. In terms of its relative importance in the manufacture of dairy products, this area has declined, since the period 1916-20. Plants in the area purchased 20 percent of all butterfat purchased by manufacturing plants in Mississippi during the period 1916-20, 14 percent during the period 1925-28, and 4 percent during the period 1941-44.

The Southwest Mississippi Area has become predominately a fluid milk area and to get a correct picture of its dairying, the amount of butterfat purchased by fluid milk and ice cream plants must be added to the amount purchased by manufacturing plants. When this was done, it was found that butterfat purchased by all dairy plants in the Area decreased from 1,443,000 pounds per year for the period 1929-32 to 1,284,000 pounds per year for the period 1937-40; however, production has been stimulated by the increased wartime demand for fluid milk and the amount of butterfat purchased by all dairy plants amounted to 2,247,000 pounds per year during the period 1941-44, an increase of 75 percent over the preceding 4-year period. Plants in the Area purchased 13 percent of the total butterfat purchased by all dairy plants in Mississippi during the period 1941-44 as compared to 9 percent for the period 1937-40, and 12 percent for the period 1929-32. See tables 21 and 22. Thus, the purchases of butterfat for fluid milk purposes have increased to such an extent that the butterfat purchased by all dairy plants amounted to over 50 percent more for the period 1941-44 than for the period 1929-32, although the amount of butterfat purchased by manufacturing plants had decreased by over 50 percent during the same period.

Table 21. Pounds of butterfat purchased from producers by all dairy plants reporting by areas, Mississippi, 1929-1944

Period	Milkshed area						Other areas	State
	Lower Northeast Miss.	Upper Northeast Miss.	Northeast Miss.	Upper Brown Loam	Central Miss.	Southwest Miss.		
	thous.	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*
1929-1932	4,655	1,324	5,979	942	1,829	1,443	2,168	12,361
1933-1936	5,314	1,996	7,310	993	1,515	1,336	2,132	13,286
1937-1940	6,243	2,964	9,207	1,189	1,522	1,284	1,626	14,828
1941-1944	6,294	3,951	10,245	862	1,750	2,247	2,255	17,359

Source: Appendix table 6.

Table 22. Percentage of total butterfat purchased from producers by all dairy plants that was purchased in each important milkshed area, Mississippi, 1929-1944

Period	Milkshed area						Other areas	State
	Lower Northeast Miss.	Upper Northeast Miss.	Northeast Miss.	Upper Brown Loam	Central Miss.	Southwest Miss.		
1929-1932	37.7	10.7	48.4	7.6	14.8	11.7	17.5	100.0
1933-1936	40.0	15.0	55.0	7.5	11.4	10.1	16.0	100.0
1937-1940	42.1	20.0	62.1	8.0	10.3	8.6	11.0	100.0
1941-1944	36.2	22.8	59.0	5.0	10.1	12.9	13.0	100.0

Source: Derived from table 12.

The amount of butterfat purchased by all dairy plants in the Southwest Area may again take up the downward trend that was in evidence before the war. In all probability, many producers who have gone into or expanded milk production during the wartime period on the basis of fluid milk prices, will find that they cannot profitably produce lower priced milk for manufacturing purposes if the wartime fluid milk markets decline in importance.

SEASONAL VARIATION IN MILK AND BUTTERFAT PURCHASES

Due to the seasonal variation in milk production, the amount of milk and butterfat purchased by dairy plants varied greatly during the various months. Monthly milk purchases varied

Table 23. Seasonal variation in the amount of milk and butterfat purchased by dairy plants, Mississippi, 1929-1944

Months	Percent of annual volume purchased each month					
	Milk			Butterfat		
	1929-1936	1937-1944	1929-1944	1929-1936	1937-1944	1929-1944
January	4.84	4.68	4.75	5.30	5.13	5.20
February	4.91	4.94	4.93	5.10	5.14	5.12
March	6.10	6.15	6.13	6.03	6.08	6.06
April	9.22	8.88	9.03	8.71	8.38	8.53
May	12.45	12.50	12.48	11.75	11.81	11.78
June	11.80	11.78	11.79	11.06	11.05	11.05
July	11.93	12.11	12.03	11.26	11.43	11.36
August	11.33	11.58	11.47	11.00	11.25	11.14
September	8.89	9.08	9.00	9.03	9.22	9.14
October	7.53	7.42	7.47	8.21	8.09	8.15
November	6.01	5.90	5.95	6.91	6.79	6.84
December	4.99	4.98	4.98	5.64	5.63	5.63
Year	100.00	100.00	100.00	100.00	100.00	100.00

Source: Computed from annual reports of dairy plants, 1929-1937, Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

from 4.8 percent of the annual volume in January to 12.5 percent in May for the 16-year period 1929-44; monthly butterfat purchases varied from 5.1 percent of the annual volume in February to 11.8 percent in May during the same period. To further emphasize the concentration of milk and butterfat purchases during the summer months, it should be pointed out that 48 percent of the milk and 45 percent of the butterfat is purchased in the 4 months of May, June, July and August. That is, almost one-half the volume of milk and butterfat is purchased in one-third of the year. See table 23.

Butterfat purchases are not concentrated in the summer months to as great an extent as milk purchases because the butterfat content of milk is at its lowest level during the summer months. The butterfat content of milk varied from a low of 4.22 percent in June to 5.18 percent in November, and averaged 4.50 percent for the year during the period 1938-44. See table 24.

Plants could operate more efficiently if they obtained a greater percentage of their volume during the winter months, and consequently, they could afford to pay higher prices for milk if this were the case. Much time and effort have been spent trying to persuade the farmers to produce more feed and to feed heavier during the winter months with the idea of producing a greater part of the annual volume during the winter months. In order to determine if any progress has been made in increasing the proportion of milk and butterfat purchased during the winter months, the 16-year period 1929-44 was divided into two 8-year periods, 1929-36, and 1937-44, and the percentage of milk and butterfat purchased each month

Table 24. Butterfat content of milk, by months, Mississippi, 1938-1944

Month	1938	1939	1940	1941	1942	1943	1944	Average
January	4.94	4.90	5.01	4.82	4.97	4.91	4.97	4.93
February	4.63	4.68	4.74	4.63	4.81	4.65	4.60	4.68
March	4.41	4.41	4.39	4.48	4.52	4.53	4.40	4.45
April	4.31	4.27	4.28	4.07	4.28	4.28	4.27	4.25
May	4.23	4.32	4.22	4.26	4.30	4.21	4.22	4.25
June	4.26	4.30	4.25	4.18	4.20	4.20	4.16	4.22
July	4.24	4.27	4.34	4.28	4.21	4.19	4.20	4.25
August	4.39	4.38	4.36	4.38	4.34	4.38	4.33	4.37
September	4.55	4.56	4.59	4.54	4.55	4.68	4.50	4.57
October	4.91	4.88	4.96	4.77	4.96	5.01	4.91	4.91
November	5.18	5.20	5.24	5.20	5.11	5.20	5.15	5.18
December	5.10	4.99	5.10	5.02	5.15	5.12	5.17	5.09
Year	4.48	4.50	4.54	4.49	4.52	4.52	4.46	4.50

Source: Computed from annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

calculated for both periods. The division of the data in this manner showed that the proportion purchased each month had not changed materially, but that what little change there had been was in the opposite direction from what plant managers would like. A slightly smaller percentage of milk and butterfat was purchased in the winter months of November to February and a slightly higher percent in the summer months of May to August during the period 1937-44 than during the period 1929-36. See table 23.

The tremendous difference in the volume of milk or its equivalent purchased by dairy plants in the winter months as compared to the summer months is brought about by a decline in the number of patrons selling milk as well as a decline in the amount of milk or its equivalent sold per patron; however, the decline in the amount of milk sold per patron is greater than the decline in the number of patrons. For example, between May and January, the high and low months in volume, the number of patrons selling milk or cream decreased 34 percent; the amount of milk or its equivalent sold per patron decreased 42 percent, with the result that the amount of milk or its equivalent purchased by dairy plants decreased 62 percent. See table 25.

The concentration of milk production in the summer months has resulted in about one-half the dairy products in Missis-

Table 25. Relative number of partons, milk or its equivalent sold per patron, and total milk or its equivalent purchased by dairy plants, by months, Mississippi, 1929-1944

Month	Relatives (May = 100)		
	Number of patrons	Milk or its equivalent sold per patron	Milk or its equivalent purchased by dairy plants
January	66	58	38
February	67	60	40
March	69	71	49
April	83	87	72
May	100	100	100
June	102	92	94
July	100	96	96
August	99	93	92
September	93	77	72
October	88	68	60
November	82	59	48
December	74	54	40

Source: Computed from annual reports of dairy plants, 1929-1944, Mississippi Department of Agriculture and Commerce; and a survey of dairy manufacturing plants, 1945.

sippi being manufactured in the 4-month period, May-August, and about two-thirds in the 6-month period April-September. Fifty-two percent of the cheese manufactured in Mississippi between 1938 and 1944 was manufactured in the 4-month period, May-August, and 69 percent in the 6-month period, April-September; 44 percent and 63 percent of the condensed milk and 45 percent and 62 percent of the butter were manufactured during the same periods. See Appendix table 7.

Relation of Seasonal Production to Plant Capacity and Efficiency of Operation

In order to determine the extent of capacity at which dairy manufacturing plants operated, the capacity and the amount of milk or its equivalent purchased each month were obtained for 12 manufacturing plants. The summarization of these data showed that these plants operated at about two-thirds of capacity during their peak month, at slightly less than one-fourth of capacity during the month in which their volume was lowest, and averaged operating at 45 percent of capacity for the year. Monthly deliveries at the plant which operated at the highest percentage of capacity for the year varied from 29 percent of capacity to over 100 percent of capacity for 2 months, and averaged 68 percent of capacity for the year. One other plant had deliveries exceeding capacity for 2 months. Monthly deliveries at the plant operating at the lowest percent of capacity for the year varied from 15 percent of capacity to 51 percent of capacity, and averaged 31 percent of capacity for the year. See figure 8.

The efficiency of operation at any plant is related directly to the percentage of capacity at which that plant operates. There are certain fixed charges such as upkeep of buildings and equipment, depreciation, interest on investment, and management cost that must be met regardless of whether the plant operates at 5 percent of capacity or 100 percent of capacity. It is readily apparent, therefore, that the cost of manufacturing a pound of cheese or of butter or condensed milk decreases continuously until the plant is operating at full capacity. It is impossible for dairy manufacturing plants to operate at 100 percent of capacity for the year because of the unavoidable variations in milk production; however, the nearer they approach this ideal, the greater will be the opportunity to increase the efficiency of the milk plant operation.

If the volume of milk or its equivalent purchased by the 12 plants discussed above could be increased until they reached 100 percent of capacity during their peak months, they would operate at 68 percent of capacity for the year instead of 45 percent. Thus, their efficiency of operation for the year would be increased considerably, and this would just about represent maximum efficiency for the average manufacturing plant in Mississippi because of the seasonal variation in milk production.

The volume of milk or its equivalent purchased per manufacturing plant can be increased by (1) increasing total milk production or (2) decreasing the number of plants operating. As shown earlier in this report, both the above factors have been working since 1932 to increase the volume handled per manufacturing plant.

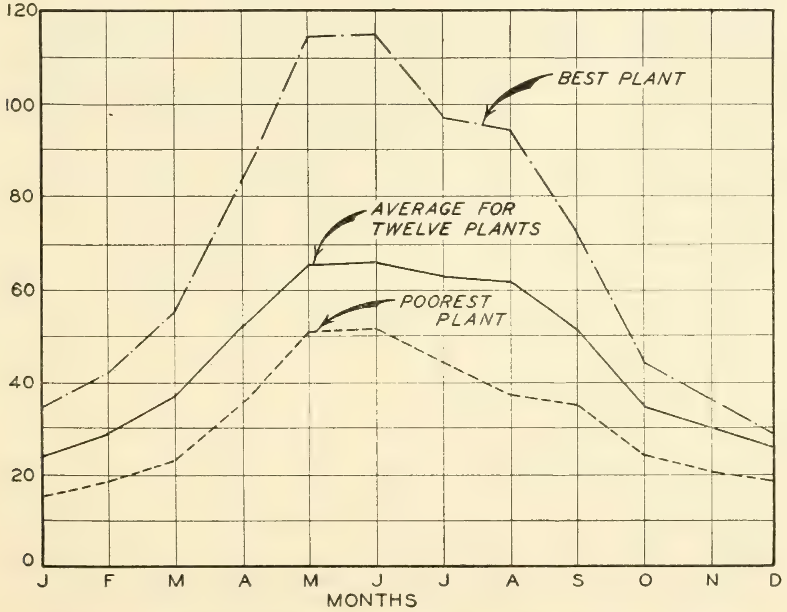


Figure 8. Percent monthly volume is of plant capacity, 12 dairy manufacturing plants, Mississippi, 1944.

Relation of Seasonal Variation in Milk Production to Efficiency of Milk Transportation

Due to the seasonal variation in milk production, the cost of transporting milk to manufacturing plants is approximately two and one-half times as great in the winter as in the summer months. The amount of milk hauled per mile by 79 milk routes averaged 22 pounds in January as compared to 53 pounds in June. The increase of 31 pounds in the amount of milk hauled per mile between January and June was the result of the number of patrons selling milk increasing from 1.46 to 2.20 per mile, and the amount of milk sold per patron per day increasing from 30 to 49 pounds. The number of patrons per mile, the milk sold per patron per day, and the amount of milk hauled per mile increased through June, then decreased thereafter. See figure 9.

Routes at two of the nine plants included in this study were run every other day during the winter months. These routes doubled their volume per mile over what it would have been if they had run every day, with the result that the vol-

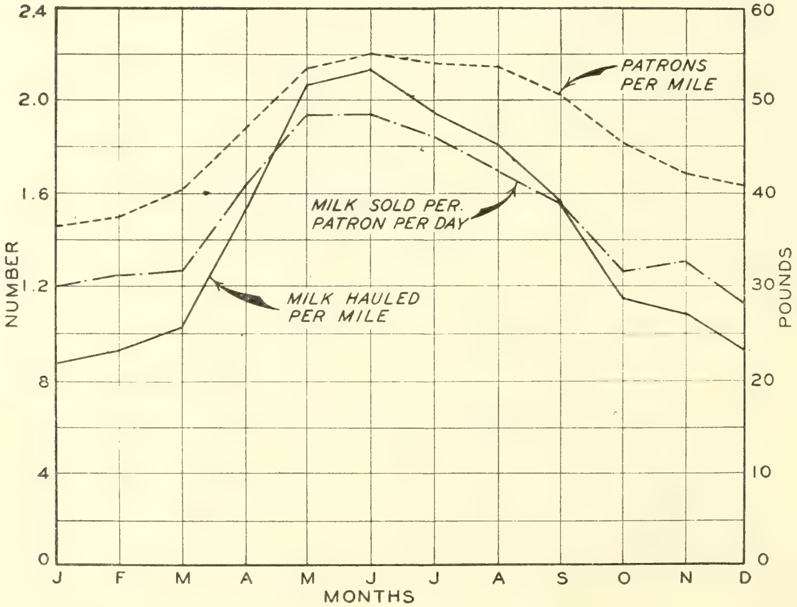


Figure 9. Patrons per mile, milk sold per patron per day and milk hauled per mile, by months, 79 milk routes, Mississippi, 1944.

ume hauled per mile during the winter months amounted to only slightly less than during the summer months.

The problem of transporting milk to manufacturing plants is more than a seasonal one because of the low annual volume hauled on many routes. The average amount of milk hauled per mile on the 79 routes studied amounted to 36.1 pounds per mile for 1944; however, the amount hauled on individual routes varied from as low as 12 pounds to as high as 98 pounds per mile for the year. Eight routes averaged hauling less than 20 pounds of milk per mile during 1944; 17 hauled from 20 to 30 pounds; 19 hauled from 30 to 40 pounds; 17 hauled from 40 to 50 pounds; 10 hauled from 50 to 60 pounds, and 8 hauled 60 pounds and above. It is interesting to note that both the patrons per mile and the amount of milk sold per patron increased consistently as the amount of milk hauled per mile increased. See table 26.

Table 26. Patron per mile, milk per patron per mile, milk hauled per mile, and length of routes in miles, 79 milk routes, Mississippi, 1944

Pounds of milk hauled per mile	Number of routes	Patron per mile	Milk per patron per day	Milk hauled per mile	Average length of routes in miles
Less than 20	8	1.12	31	16.8	63.8
20.0-29.9	17	1.42	36	24.9	66.2
30.0-39.9	19	1.88	40	34.5	57.2
40.0-49.9	17	2.20	43	45.5	53.6
50.0-59.9	10	2.54	44	54.7	61.5
60.0 and above	8	2.88	59	77.6	19.9
Total and average	79	1.86	39	36.1	55.8

Source: Survey of nine dairy manufacturing plants, 1945.

PRICES PAID PRODUCERS FOR MILK AND BUTTERFAT

Prices paid producers for milk and butterfat have varied considerably during the past 16 years. The price paid for 100 pounds of 4.5 percent milk varied from $0.97 in 1932 to $2.77 in 1944 at cheese plants; from $0.98 in 1932 to $3.07 in 1944 at condenseries, and from $1.49 in 1932 to $3.83 in 1944 at fluid milk plants. The price paid per pound of butterfat in cream varied from $0.15 in 1932 to $0.53 in 1944. In other words, cheese plants paid 2.9 times as much for milk in 1944 as 1932, condenseries, 3.1 times as much, and fluid milk plants, 2.6 times as much. Butterfat in cream sold for 3.5 times as much in 1944 as in 1932. If the government subsidy of $0.40 to $0.70 per hundred pounds for the production of milk and $0.06

to $0.17 per pound for the production of butterfat in cream were added to the amount paid by dairy plants, the increase in the prices paid producers between 1932 and 1944 would be even more pronounced.

From 1929 to 1944 fluid milk plants paid an average of 32.8 percent more per 100 pounds of 4.5 percent milk than condenseries; condenseries paid an average of 3.4 percent more per hundred pounds of 4.5 percent milk than cheese plants; and cheese plants paid an average of 24.3 percent more per pound of butterfat in milk than creameries and other plants paid per pound of butterfat in cream. See table 27.

Seasonal Variation in Prices

During the 3-year period, 1938-40, the actual price paid for milk at condenseries and cheese plants varied from 89 percent of the average annual price in June to 131 percent in December; however, when the monthly prices were adjusted to the price that would have been paid for 4.5 percent milk, it was found that the price varied from 95 percent of the average annual price in May, June, and August to 112 percent in January. Therefore, a considerable part of the seasonal variation

Table 27. Prices received by producers per hundred pounds of milk sold to cheese plants, condenseries and fluid milk plants, and per pound of butterfat in cream at all plants, Mississippi, 1929-1944

Year	Price paid per 100 pounds of milk at			Price paid per pound of butterfat in cream
	Cheese plants	Condenseries	Fluid milk plants	
1929	$2.39	$2.27	$2.99	$0.44
1930	2.04	2.02	2.66	0.36
1931	1.35	1.37	2.10	0.22
1932	0.97	0.98	1.49	0.15
1933	1.08	1.11	1.61	0.18
1934	1.20	1.29	1.78	0.21
1935	1.43	1.47	1.98	0.24
1936	1.73	1.76	2.03	0.31
1937	1.74	1.76	2.13	0.31
1938	1.33	1.37	2.12	0.26
1939	1.34	1.39	2.15	0.25
1940	1.51	1.57	2.25	0.28
1941	2.08	2.02	2.49	0.36
1942	2.21	2.26	2.98	0.41
1943	2.68	3.04	3.61	0.52
1944	2.77	3.07	3.83	0.53
Average	1.74	1.80	2.39	0.31

Source: Annual reports of dairy plants, 1929-1944, Mississippi, Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

in the actual prices paid for milk at cheese plants and condenseries is due to the seasonal change in the butterfat content of milk. See the upper part of figure 10. The shaded area in this figure shows the variation in price that is due to the seasonal change in the butterfat content of milk and the dotted line shows the true seasonal variation in price.

The increased demand for milk products during the war has resulted in the seasonal variation in prices being modified to some extent. The price paid for 4.5 percent milk at condenseries and cheese plants varied from 97 percent of the average annual price in June to 105 percent in December, a variation only about half as great as in the pre-war period, 1938-40. See the lower part of figure 10. Since the wartime period, 1942-44, is abnormal, the seasonal variation in prices that prevailed during the pre-war period, 1938-40, is the one most likely to prevail in the postwar period.

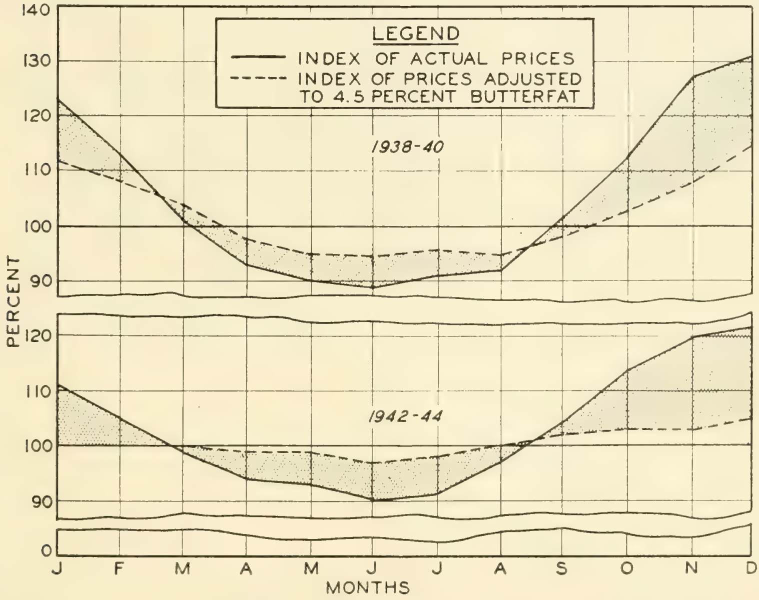


Figure 10. Index of seasonal variation in prices paid per hundred pounds of milk at cheese plants and condenseries, Mississippi, 1938-1940 and 1942-1944. (Average annual price-100).

Note: The shaded area represents the seasonal variation in price due to the seasonal variation in the butterfat content of milk.

The seasonal variation in the price of butterfat in cream is similar to that of milk purchased by cheese plants and condenseries; however, the seasonal variation in the prices paid for fluid milk is not nearly so great. During the period 1938-40, the price paid for 100 pounds of 4.5 percent milk varied from 97 percent of the average annual price in June to 105 percent in February, a variation only about one-half as great as for milk sold to cheese plants and condenseries. This is the result of fluid milk plants having a rather uniform market, both as to demand and price throughout the year.

The seasonal variation in price is related directly to the seasonal variation in production; that is, prices are lowest when the most milk is being sold and highest when milk sales are at their lowest point. In fact, the price paid per hundred pounds of milk at condenseries and cheese plants between 1938 and 1940 was below the average annual price in every month in which milk purchases were above average, and above the average annual price in every month in which milk purchases were below average. See figure 11.

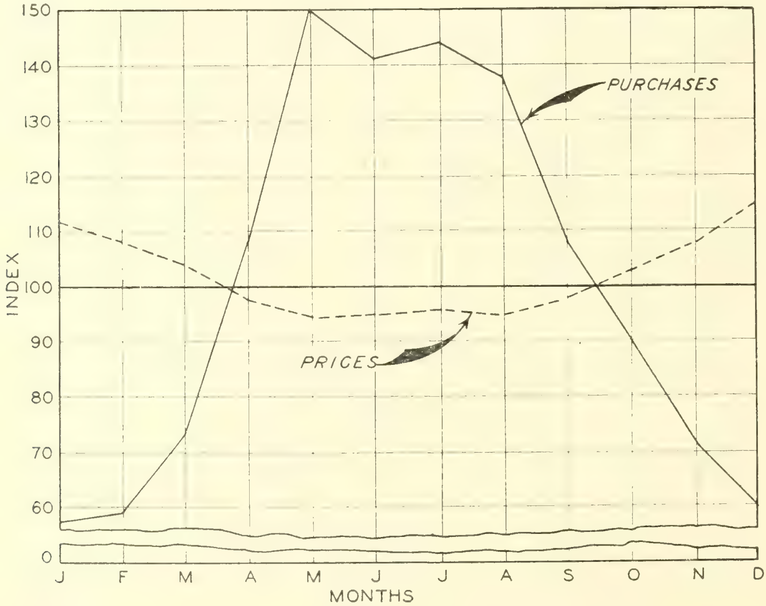


Figure 11. Relation of the index of seasonal purchases to the index of seasonal prices at cheese plants and condenseries, Mississippi. (Average monthly purchases 1929-1944=100. Average annual price, 1938-40, adjusted to 4.5 percent butterfat = 100.)

SUMMARY

Dairying as a major farm enterprise is relatively undeveloped in Mississippi as compared to some of the more concentrated dairy areas of the United States such as the Middle Atlantic and East North Central States. Although Mississippi's relative position in the production of milk in the United States has remained about the same for the last 40 years, her relative position in milk sales has increased considerably. With regard to their relative contribution to total farm income, dairy products have doubled in importance since the period 1924-28.

Commercial dairy production did not get started in Mississippi until after the boll weevil came in and played havoc with cotton production for several years. The boll weevil infestation began to get serious about 1908 or 1909; and the first creamery to continue operation was established at Mississippi A & M College (now Mississippi State College) in 1912. This creamery was followed by two others in 1913, four in 1914, two in 1915, and six in 1916. By 1919, 24 creameries were in operation and the number remained at about this level until the first condensery was established in 1926 and the first cheese plant in 1927. The number of manufacturing plants increased rapidly to 39 in 1928, then more slowly to a peak of 45 in 1932 and 1933. Since that time, the number in operation has declined until only 31 plants were in operation in 1944. The decline in the number of creameries, which cannot pay as much per pound of butterfat in cream as cheese plants and condenseries can pay per pound of butterfat in milk, accounts for most of the decrease in manufacturing plants during this period.

The amount of butterfat purchased by manufacturing plants has increased, period by period, since the first plant was established in 1912, although at a slower rate after 1932. The amount of butterfat purchased from producers increased from 3,096,000 pounds per year for the period 1913-20 to 11,172,000 pounds per year for the period 1929-32, and 13,997,000 pounds for the period 1941-44.

Relatively speaking, the amount of butterfat purchased by all dairy plants increased more between 1929-32 and 1941-44 than the amount purchased by manufacturing plants alone.

The amount of butterfat purchased by all dairy plants increased 40 percent between 1929-32 and 1941-44 as compared to an increase of 25 percent for manufacturing plants. The 40-percent increase in the amount of butterfat purchased by all dairy plants between 1929-32 and 1941-44 was the result of a 73 percent increase in the number of patrons selling butterfat and a 19 percent decrease in the amount of butterfat sold per patron.

Whole milk, and consequently solids not fat, is becoming relatively more and more important in the manufacture of dairy products in Mississippi. Manufacturing plants purchased 84 percent of their butterfat in milk during the period 1941-44 as compared to 10 percent for the period 1921-24. Solids not fat manufactured into dairy products increased 93 percent between 1929-32 and 1941-44 as compared to an increase of only 11 percent in the amount of butterfat manufactured.

Volume per manufacturing plant has continued to increase since the first plant was established. The annual volume of butterfat manufactured per plant increased from 60,000 pounds for the period 1912-20 to 226,000 pounds for the period 1928-32, and 347,000 pounds for the period 1941-44. The volume of butterfat purchased per manufacturing plant increased enough (73 percent) between 1929-32 and 1941-44 to bring about a 25 percent increase in the amount of butterfat purchased from producers, although the number of manufacturing plants had decreased 27 percent during the same period.

Since the period 1929-32, butter has become relatively less important, and condensed milk, cheese and concentrated by-products more important in the dairy industry in Mississippi. The amount of butter manufactured decreased 40 percent between 1929-32 and 1941-44, as compared to an increase of 90, 102, and 150 percent, respectively, in the manufacture of condensed milk, cheese, and skim milk products.

During the last four years, 1941-44, an average of 51,000,000 pounds of condensed milk, 9,914,000 pounds of cheese, 4,454,000 pounds of butter, 4,682,000 pounds of condensed skimmed milk, and 1,635,000 pounds of non-fat dry milk solids were manufactured per year.

The dairy manufacturing industry has become more and more concentrated in the 12 counties comprising the Northeast Mississippi Milkshed Area. Plants in this Area purchased

71 percent of the butterfat purchased by manufacturing plants in Mississippi for the period 1941-44 as compared to 53 percent for the period 1929-32, and 41 percent for the period 1916-20.

The Central Mississippi, Southwest Mississippi, and Upper Brown Loam Milkshed Areas have all declined in relative importance in dairy manufacturing; however, fluid milk production has increased to a considerable amount in the last two Areas.

Due to the seasonal variation in milk production, dairy plants purchase approximately one-half their annual volume in the 4 months of May to August and about one-fifth their annual volume during the 4 months of November to February. The tremendous difference in the volume of milk or its equivalent purchased by dairy plants in the winter months as compared to the summer months is brought about by a decline in the number of patrons selling milk or cream, as well as a decline in the amount sold per patron. There was no material change in the seasonal variation in milk production in the 16 years from 1929-44.

The seasonal variation in milk production affects the percentage of capacity at which plants operate and, consequently, their efficiency of operation. In 1944, a sample of the manufacturing plants (12) operated at about two-thirds of capacity during their peak month, at slightly less than one-fourth of capacity during the month in which their volume was lowest, and averaged operating at 45 percent of capacity for the year as compared to 31 percent for the poorest plant.

Due to the seasonal variation in milk production, the per unit cost of transporting milk to manufacturing plants is approximately two and one-half times as great in the winter as in the summer months; however, the problem of transporting milk to manufacturing plants is more than a seasonal one because of the low annual volume hauled on many routes.

Fluid milk plants pay more for milk than condenseries, condenseries pay more than cheese plants, and cheese plants pay more for butterfat in milk than creameries pay for butterfat in cream. Prices paid for milk and cream vary directly with seasonal productions; that is, prices are lowest when production is highest and prices highest when production is lowest.

APPENDIX

Table 1. Plants manufacturing dairy products, Mississippi, 1912-1944

Year	Creameries	Condenseries	Cheese plants	Concentrated by-products plants	Total plants
1912	1	....	....	....	1
1913	3	....	....	....	3
1914	7	....	....	....	7
1915	9	....	....	....	9
1916	15	....	....	....	15
1917	20	....	....	....	20
1918	22	....	....	....	22
1919	24	....	....	....	24
1920	25	....	....	....	25
1921	24	....	....	....	24
1922	25	....	....	....	25
1923	23	....	....	....	23
1924	25	....	....	....	25
1925	25	....	....	....	25
1926	25	1	....	....	26
1927	26	2	3	....	31
1928	22	4	13	....	39
1929	26	4	13	7	44
1930	27	4	11	7	43
1931	25	4	13	7	43
1932	28	4	12	7	45
1933	28	4	12	7	45
1934	24	4	10	7	39
1935	25	4	11	6	41
1936	21	4	13	7	40
1937	19	4	14	7	39
1938	16	4	16	8	38
1939	18	4	17	8	41
1940	15	4	15	8	36
1941	15	4	14	6	35
1942	12	4	14	5	32
1943	9	4	14	6	29
1944	11	4	14	6	31

Source: "Growth of the Dairy Industry in Mississippi from 1912 to 1922," by L. A. Higgins, Dairy Specialist, Mississippi Extension Service; and the annual reports of dairy plants, 1919-1944, Mississippi Department of Agriculture and Commerce.

Table 2. Pounds of milk and cream purchased by dairy manufacturing plants, Mississippi, 1919-1944

Year	Milk purchased *thous.*	Butterfat in milk *thous.*	Butterfat purchased in cream *thous.*	Total butterfat purchased *thous.*	Total milk equivalent[1] purchased *thous.*	Percent of butterfat purchased in milk
1919	5,665	265	2,909	3.174	73,313	8.4
1920	6,703	311	2,706	3,017	69,630	10.3
1921	11,628	521	4,373	4,894	113,339	10.6
1922	10,607	485	5,531	6,016	139,222	8.1
1923	11,105	505	5,881	6,386	147,888	7.9
1924	18,681	853	5,297	6,150	141,870	13.9
1925	21,210	985	5,283	6,268	144,070	15.7
1926	40,730	1,888	5,715	7,603	173,635	24.8
1927	77,960	3,651	6,673	10,324	233,160	35.4
1928	106,034	4,932	6,142	11,074	248,877	44.5
1929	142,039	6,420	5,293	11,713	265,138	54.8
1930	137,036	6,152	3,925	10,077	228,330	61.0
1931	150,860	6,914	3,712	10,626	237,188	65.1
1932	172,126	7,797	4,475	12,272	276,194	63.5
1933	172,527	7,785	4,858	12,643	285,512	61.6
1934	170,310	7,719	3,729	11,448	257,046	67.4
1935	169,892	7,854	3,323	11,177	247,175	70.3
1936	197,435	8,908	3,155	12,063	270,796	73.8
1937	230,488	10,324	3.160	13,484	303,971	76.6
1938	270,756	12,111	3,611	15,722	254,729	77.0
1939	215,412	9,692	3,097	12,789	287,441	75.8
1940	184,799	8,335	2,463	10,798	242,078	77.2
1941	239,805	10,814	2,770	13.584	304,218	79.6
1942	258,991	11,616	2,482	14,098	316,716	82.4
1943	243,493	10,978	1,991	12,969	289,806	84.6
1944	301,738	13,429	1.909	15,338	346,124	87.6

Source: Annual reports of dairy plants, 1919-1937, Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

[1] Pounds of whole milk purchased plus the milk equivalent of butterfat purchased as cream. The milk equivalent of cream was calculated by dividing the butterfat purchased in cream by 4.3 and multiplying by 100. It was estimated that a 0.2 pounds of the average 4.5 pounds of butterfat in 100 pounds of milk was left in the skim milk on the average farm.

Table 3. Pounds of milk and cream purchased by all dairy plants reporting, Mississippi, 1929-1944

Year	Milk purchased *thous.*	Butterfat in milk *thous.*	Butterfat purchased in cream *thous.*	Total butterfat purchased *thous.*	Total milk equivalent[1] purchased *thous.*	Percent of butterfat purchased in milk
1929	156,999	7,096	5,839	12,935	292,777	54.9
1930	151,108	6,992	4,143	11,135	247,453	62.8
1931	171,774	7,864	3,887	11,751	262,167	66.9
1932	192,531	8,700	4,922	13,622	306,997	63.9
1933	187,496	8,454	5,489	13,943	315,155	60.6
1934	187,190	8,493	4,306	12,799	287,332	66.4
1935	194,197	8,917	3,709	12,626	280,440	70.6
1936	224,547	10,152	3,625	13,777	308,847	73.7
1937	260,351	11,710	3,553	15,263	342,982	76.7
1938	296,004	13,259	3,784	17,043	383,990	77.8
1939	241,657	10,883	3,374	14,257	320,116	76.3
1940	221,894	10,069	2,681	12,750	284,256	79.0
1941	304,348	13,665	3,041	16,706	375,066	81.8
1942	325,499	14,706	2,757	17,463	389,609	84.2
1943	310,413	14,022	2,267	16,289	363,146	86.1
1944	372,950	16,649	2,330	18,979	427,137	87.7

Source: Annual report of dairy plants, 1919-1937, Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

[1] See footnote 1 to appendix table 2.

Table 4. Dairy products manufactured and the amount of butterfat manufactured into each product, Mississippi, 1912-1944

Year	Pounds of			Pounds of butterfat manufactured into			
	Butter	Cheese	Condensed milk	Butter	Cheese	Condensed milk	Dairy products
	thous.	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*
1912	17	--	--	14	--	--	14
1913	184	--	--	148*	--	--	148
1914	336	--	--	270*	--	--	270
1915	590	--	--	475*	--	--	475
1916	1,474	--	--	1,186*	--	--	1,186
1917	2,648	--	--	2,131*		--	2,131
1918	2,948	--	--	2,375		--	2,375
1919	3,362	--	--	2,719	--	--	2,719
1920	3,162	--	--	2,575	--	--	2,575
1921	5,329	--	--	4,297	--	--	4,297
1922	6,671	--		5,411	--		5,411
1923	7,045	--	--	5,475	--	--	5,475
1924	6,376	--	--	5,152	--	--	5,152
1925	6,170	--		5,028	--		5,028
1926	6,903		6,266*	5.571	--	504*	6,075
1927	8,220	198	20,166*	6,638	61*	1,613*	8,312
1928	7,544	2,531	23,773*	6,101	785*	1,891*	8,777
1929	7,510	4,587	26,268	6,165	1,777	2,098	10,040
1930	6,611	4,436	23,630	5,290	1,529	2,037	8,856
1931	6,500	4,901	28,450	5,261	1,664	2,286	9,211
1932	8,884	5,696	29,284	7,141	2,058	2,269	11,468
1933	8,169	6,486	27,842	6,554	2,183	2.277	11,014
1934	6,974	6,519	27,726	5,620	2,226	2,398	10,244
1935	6,653	7,285	29,047	5,358	2,281	2,226	9,865
1936	6,050	7,762	36,346	4,865	2,540	2,875	10,280
1937	6,198	9,317	39,119	5,016	2,996	3.253	11,265
1938	7,315	11,006	45,101	5,904	3,606	3,757	13,267
1939	5,753	8,422	44,553	4,614	2,727	3,472	10,813
1940	4,787	6,983	39,723	3,779	2,173	3,191	9,143
1941	5,346	9,514	48,556	4,286	3,161	4,050	11,497
1942	4,189	10,471	54,506	3,358	3,763	4,296	11,417
1943	3,791	8,701	45,426	3,038	3,942	3,698	9,778
1944	4,491	10,969	55,972	3,615*	3,400*	4,418*	11,433

Source: "Growth of the Dairy Industry in Mississippi from 1912 to 1922," by L. A. Higgins, Dairy Specialist, Mississippi Extension Service; "Annual Report of the Dairy Extension," June 1917, Starkville, Mississippi; annual reports of dairy plants, 1919-1937, Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

*Computed.

Table 5. Pounds of butterfat purchased from producers by plants manufacturing dairy products, by areas, Mississippi, 1916-1944

Year	Lower Northeast Mississippi Milkshed Area	Upper Northeast Mississippi Milkshed Area	Total Northeast Mississippi Milkshed Area	Upper Brown Loam Milkshed Area	Central Mississippi Milkshed Area	Southwest Mississippi Milkshed Area	Rest of State	State
	thous.	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*
1916	621	16	637	17	156	320	256	1,386
1919	1,159	80	1,239	58	734	608	535	3,174
1920	1,133	105	1,238	88	689	548	454	3,017
1921	1,853	186	2,039	246	1,000	875	734	4,894
1922	2,477	321	2,798	255	1,129	964	870	6,016
1923	2,596	434	3,030	286	1,052	910	1,108	6,386
1924	2,513	355	2,868	361	876	1,042	1,002	6,150
1925	2,062	349	2,411	322	781	1,210	1,544	6,268
1926	3,007	408	3,415	354	911	1,265	1,658	7,603
1927	4,269	1,218	5,487	422	970	1,391	2,054	10,324
1928	4,294	1,505	5,799	683	1,344	1,192	2,056	11,074
1929	4,249	1,470	5,719	977	1,861	1,195	1,961	11,713
1930	4,197	947	5,144	657	1,716	1,206	1,354	10,077
1931	4,586	1,248	5,834	885	1,951	1,266	690	10,626
1932	5,114	1,631	6,745	1,073	1,748	1,306	1,400	12,272
1933	5,459	1,549	7,008	1,099	1,698	1,208	1,630	12,643
1934	4,971	1,785	6,756	985	1,496	941	1,270	11,448
1935	4,774	2,170	6,944	915	1,424	694	1,200	11,177
1936	5,355	2,478	7,833	773	1,441	880	1,136	12,063
1937	6,174	2,896	9,070	1,268	1,599	800	747	13,484
1938	6,922	3,713	10,635	1,470	1,857	818	942	15,722
1939	6,082	2,795	8,877	1,033	1,370	757	752	12,789
1940	5,053	2,418	7,471	832	1,257	602	636	10,798
1941	6,069	3,501	9,570	929	1,608	558	919	13,584
1942	6,058	3,845	9,903	1,149	1,867	566	613	14,098
1943	5,670	3,744	9,414	377	1,646	571	961	12,969
1944	6,316	4,601	10,917	833	1,877	625	1,086	15,338

Source: "Annual Report of the Dairy Extension Division," June, 1917, Starkville, Mississippi; annual report of dairy plants, 1919-1944; Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

Table 6. Pounds of butterfat purchased from producers by all dairy plants reporting, by areas, Mississippi, 1929-1944

Year	Lower Northeast Mississippi Milkshed Area	Upper Northeast Mississippi Milkshed Area	Total Northeast Mississippi Milkshed Area	Upper Brown Loam Milkshed Area	Central Mississippi Milkshed Area	Southwest Mississippi Milkshed Area	Rest of State	State
	thous.	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*	*thous.*
1929	4,341	1,470	5,811	1,048	1,864	1,345	2,867	12,935
1930	4,292	947	5,239	715	1,723	1,428	2,030	11,135
1931	4,713	1,248	5,961	885	1,980	1,484	1,441	11,751
1932	5,273	1,632	6,905	1,119	1,748	1,513	2,337	13,622
1933	5,607	1,550	7,157	1,144	1,698	1,475	2,467	13,943
1934	5,157	1,785	6,942	1,039	1,496	1,150	2,172	12,799
1935	5,013	2,170	7,183	962	1,424	1,122	1,935	12,625
1936	5,477	2,480	7,957	827	1,441	1,596	1,956	13,777
1937	6,347	2,900	9,247	1,310	1,599	1,460	1,647	15,263
1938	7,105	3,723	10,828	1,506	1,857	1,190	1,662	17,043
1939	6,286	2,809	9,095	1,061	1,370	1,172	1,559	14,257
1940	5,234	2,423	7,657	880	1,264	1,316	1,633	12,750
1941	6,304	3,509	9,813	960	1,608	2,213	2,112	16,706
1942	6,343	3,897	10,240	1,199	1,866	2,226	1,932	17,463
1943	5,952	3,749	9,701	417	1,645	2,043	2,483	16,289
1944	6,578	4,649	11,227	872	1,878	2,507	2,495	18,979

Source: Annual reports of dairy plants, 1929-1944, Mississippi Department of Agriculture and Commerce; and the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

Table 7. Seasonal variation in dairy products manufactured and fluid milk sold, Mississippi, 1938-1944

Month	Percent of annual volume manufactured each month				Percent of annual volume of fluid milk sold each month
	Butter	Cheese	Condensed milk	Ice cream	
January	5.41	3.98	4.96	3.85	6.94
February	5.53	4.30	5.63	4.02	6.67
March	5.35	5.11	6.84	6.07	7.99
April	7.65	8.39	10.02	7.81	8.62
May	11.97	14.42	11.64	10.33	9.19
June	10.30	12.76	10.88	12.20	9.00
July	10.98	12.47	11.58	12.74	9.27
August	11.93	12.24	11.35	12.51	8.72
September	9.14	8.97	9.07	11.23	8.53
October	8.67	7.27	7.15	9.17	8.66
November	7.54	5.64	5.84	5.81	8.22
December	5.53	4.44	5.06	4.26	8.17
Year	100.00	100.00	100.00	100.00	100.00

Source: Computed from the annual summaries of dairy production, 1938-1944, Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

Table 8. Seasonal variation in milk purchased from producers, by areas, Mississippi, 1938-1944

Month	Milkshed area				
	Upper Northeast Mississippi[1]	Lower Northeast Mississippi[1]	Upper Brown Loam[1]	Central Mississippi[1]	Southwest Mississippi[2]
January	5.60	4.17	4.56	4.41	6.83
February	5.54	4.80	4.39	4.47	6.67
March	6.92	6.58	5.28	6.10	7.83
April	9.12	9.81	8.70	9.42	8.99
May	12.54	13.02	13.17	12.33	9.95
June	11.85	12.49	12.48	12.08	9.55
July	11.79	12.87	12.50	12.69	9.81
August	10.86	12.07	11.51	11.50	9.19
September	8.23	9.23	9.13	8.97	8.56
October	6.32	6.79	7.00	7.22	8.19
November	5.63	4.46	5.89	6.07	7.16
December	5.62	3.71	5.39	4.74	7.27
Total	100.00	100.00	100.00	100.00	100.00

Source: Annual reports of dairy plants, 1938-1944, Mississippi Department of Agriculture and Commerce.

[1] Based on purchases at one plant.

[2] Based on purchases at two plants.

Table 9. Average butterfat content of milk by areas, by month, Mississippi, 1938-1944

Month	Milkshed area				
	Upper Northeast Mississippi[1]	Lower Northeast Mississippi[1]	Upper Brown Loam[1]	Central Mississippi[1]	Southwest Mississippi[2]
January	5.11	5.02	4.92	5.01	4.81
February	4.88	4.65	4.69	4.70	4.68
March	4.65	4.39	4.40	4.43	4.58
April	4.35	4.29	4.18	4.27	4.47
May	4.29	4.29	4.18	4.25	4.44
June	4.26	4.28	4.19	4.14	4.37
July	4.23	4.36	4.27	4.19	4.34
August	4.31	4.53	4.37	4.35	4.42
September	4.56	4.80	4.59	4.59	4.55
October	4.99	5.31	4.95	4.92	4.72
November	5.22	5.65	5.21	5.22	4.84
December	5.28	5.38	5.10	5.14	4.87
Year	4.56	4.60	4.48	4.49	4.57

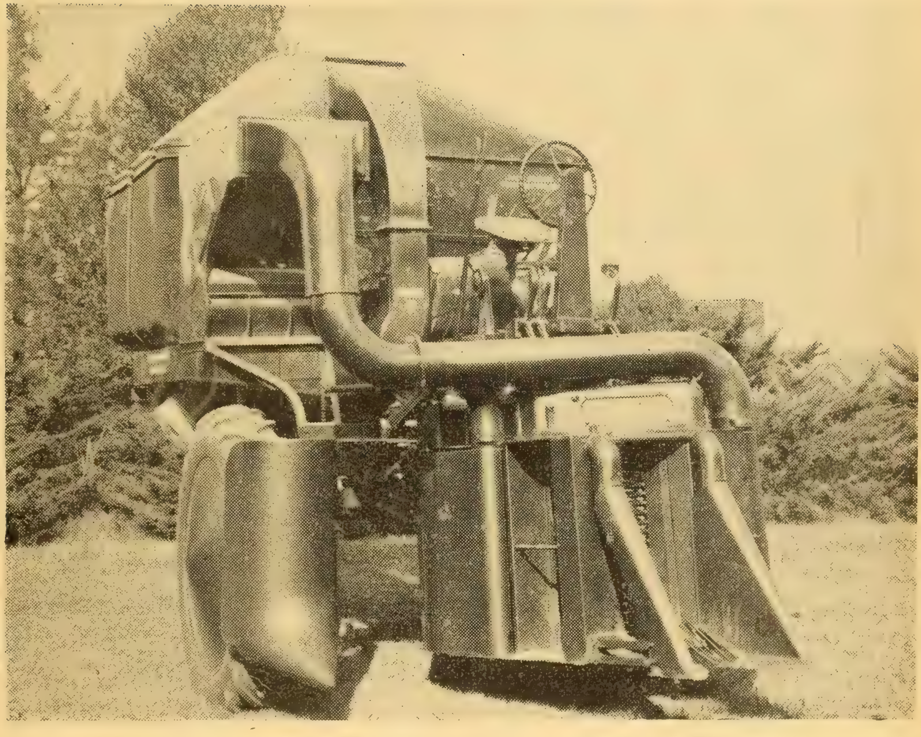
Source: Annual reports of dairy plants, 1938-1944, Mississippi Department of Agriculture and Commerce.

[1] Based on purchases at one plant.

[2] Based on purchases at two plants.

BULLETIN 423 SEPTEMBER 1945

Mechanical Production of Cotton



High drum International cotton harvester.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

Summary

1. Cotton was produced without hand labor by cross-plowing, flame cultivation, and machine picking. In drilled cotton, flamed and machine picked, hand labor was used only for additional thinning following the Dixie cotton chopper.

2. Checked or cross-plowed cotton outyielded drilled cotton, had longer staple, its seed was lower in free fatty acid and higher in grade, and the yarn was stronger and of equal appearance. The extended drought may have favored checked cotton, as there were fewer plants per acre on the checked than on the drilled plots.

3. Defoliation did not affect the yield or foreign-matter content of seed cotton. It did reduce the moisture content of seed cotton, lint, and seed. The grade of hand-picked cotton was slightly lowered, but an improvement of 0.7 of one grade for machine-picked cotton was due to defoliation. Defoliation did not materially affect the grade of cottonseed, but did reduce slightly the moisture and free fatty acid content. It did not change the spinning value of the lint.

4. Flaming versus hoeing showed no difference in the values obtained on seed cotton, lint, and spinning. Seed showed a highly significant difference for free fatty acid and significant difference for grade in favor of flaming.

5. The mechanical cotton picker picked 85 percent as much cotton from the plants as did the hand pickers. Machine-picked seed cotton was materially higher in moisture and foreign-matter content than hand-picked. It was three grades below hand picking, but the length and strength were not affected. The seed of machine-picked cotton had a highly significantly higher moisture and free fatty acid content, and was significantly lower in grade than seed from hand-picked cotton. Although the picker and card waste was much greater for machine-picked cotton, spun yarns were stronger and equal in appearance for 22s, 44s, and 60s sizes when compared with hand-picked cotton. The cotton gleaned behind the machine was almost 3/32 of an inch shorter and slightly stronger than the lint picked by hand or by the machine.

MECHANICAL PRODUCTION OF COTTON[1]

By P. W. GULL and J. E. ADAMS[2]

The need for studies to further the mechanization of cotton and other crops is paramount. Losses of labor to industry from the South were accelerated as the war progressed. Cotton unpicked at planting time in 1945 was mute evidence of the loss of labor since the 1944 crop was planted.

Welch and Miley (1)[3] give data showing a labor requirement of 133 man hours per acre for cotton production, the highest for any crop commonly grown in the South. At the same time, the value of farm machinery per crop acre in the Yazoo-Mississippi Delta is $7.68, while the average for the United States is $10.12. Although it is well known that a family can produce more cotton than it can harvest, and it is conceded that mechanical pickers would help to increase capacity and efficiency when used to pick this excess production, it is nevertheless evident that entire mechanized production of the crop is necessary. Labor can not be subsidized on a yearly basis simply to produce the crop. These points were recognized by the Mississippi Legislature which made available a special fund for these studies for the biennium July 1, 1944-June 30, 1946.

Serious losses of labor to industry have greatly increased interest in the possibilities for complete mechanization of the cotton crop. Competition from rayon and other synthetics is more than a threat. Regardless of labor shortages, of other competition, and the uncertainty of world trade adjustments, increased efficiency, with lowered costs of production, always mean greater profits to the producer. Better yielding varieties of cotton, bred to meet demands of a more exacting trade, and mechanical production, go hand in hand with better fertility practices and good management.

At the end of the 1943 season, the first year that the "Sizz Weeder", or flame cultivator, was tested, it was concluded (2) that it offered the only promise at present for replacement of the hoe in the control of grass and weeds in cotton production. Improvements of the machine used in 1943 have been reported (2), (3). Experimental areas have been successfully picked by mechanical means over a period of years at the Delta Station, and the mechanical picker has been steadily improved. An International Harvester Company cotton picker was purchased in 1944 for these tests from the lot commercially available.

The possibility of both the International Harvester Company's cotton picker and the flame cultivator becoming farm implements led the Delta Experiment Station in 1944 to undertake an extensive experimental program in the mechanical production of cotton. Involved in this program are all farm machines and cultural practices that may be made available to the cotton farmer and the various combinations of these machines for the complete mechanical production of a cotton crop.

Realizing that an understanding of the effects of mechanization on lint quality is of great economic importance, and having at Stoneville modern facilities to study such effects, full advantage was taken in the planning and execution of the program by cooperation of the U. S. Cotton Ginning Laboratory, Bureau of Plant Industry, Soils, and Agricultural Engineering; the Fiber Laboratory of the Production and Marketing Administration, United States Department of Agriculture; and the Advisory Research Committee of the Delta Council; and the Delta Branch Experiment Station. Also realizing the difficulties of obtaining reliable cost data while thus working on small areas, the Agricultural Economics Department of the main station was asked to join in the program by cooperating with planters using mechanical pickers to obtain data on operational costs, and effect of picking methods on values of commercial lots of cotton.

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[1] A cooperative program between the U. S. Department of Agriculture, Cotton Ginning Laboratory, Charles A. Bennett in charge of engineering, and Leo Gerdes in charge of fiber and cottonseed testing laboratories; and Delta Experiment Station.

[2] Agronomist and superintendent, Delta Branch Experiment Station, respectively.

Experimental Procedure

This report gives data on results obtained from various cultural and harvesting methods used in production and harvesting cotton in 1944. Comparisons made in the experiment were:

(1) Cotton cross-plowed to a checked stand versus drilled cotton;

(2) Flamed cotton versus hoed (plantation practice);

(3) Defoliated versus undefoliated; and

(4) Hand-picked versus machine-picked cotton.

The design of the experiment was a four by four Latin square replicated once, giving eight replications to the whole plot treatments. Each whole plot was "split" twice, once for the flaming versus hoeing comparisons, and once for the hand-picking versus machine-picking comparisons. The whole plot comparisons were the four possible combinations of checked versus drilled and defoliated versus undefoliated cotton. The whole plots were 107 feet long and 16 rows wide, with four border rows on either side, and alleyways for turning between blocks. The rows were 40 inches wide.

The cotton was drilled on low beds. To obtain the checked stand of cotton, the drilled rows were cross-plowed with a four-row cultivator using disc-hillers in the first cross-plowing. Setting the disc-hillers to throw away from each other, the hills can be cut to the desired length without injuring the plants left in the hills. Lapping of one or two rows is necessary to give accuracy to the row widths. The cultivator was set on 40-inch centers, thus no changing of the setting of the cultivator was necessary when shifting from cultivation with the rows to cross-plowing, i. e., cross-cultivation.

In the cross-planted cotton no additional thinning was done, or was necessary, either in plots where it was hoed or plots flamed for the control of grass and weeds. The cross-plowed plots were cultivated or flamed the same number of times as the drilled cotton, and were cross-plowed every other cultivation except the last two times when they were plowed with the rows. **The cotton in the cross-plowed, flamed, machine-picked plots was produced entirely by machinery with no hand work whatsoever.**

Thinning of the plots on which the cotton was left in the drill was accomplished in two ways: First, thinned and hoed by hand as in regular plantation practice; and second, thinned by mechanical chopping. In the latter plots, the stand was thinned by using the Dixie cotton chopper. Field conditions were not favorable for the efficient operation of this chopper; consequently, some hand work was necessary in getting the desired stand of cotton. All subsequent control of grass and weeds was by flaming.

The plots were further divided and half of each plot was hand picked and half was machine picked.

Yields of Seed Cotton

Table 1 gives data for seed cotton and lint as they are affected by the several methods of management. Yields of seed cotton are given in pounds per acre, and have all been increased by 10 percent from their oven-dry, trash-free weights to bring hand-picked and machine-picked cotton to a uniform moisture basis. The yield of checked cotton was above that of drilled cotton. Although the difference between the two yields is significant, checked cotton would not always be expected to out-yield drilled cotton. In 1944 an extended drought developed during the period of growth when the plants were fruiting most abundantly. The effect of dry weather may have been more

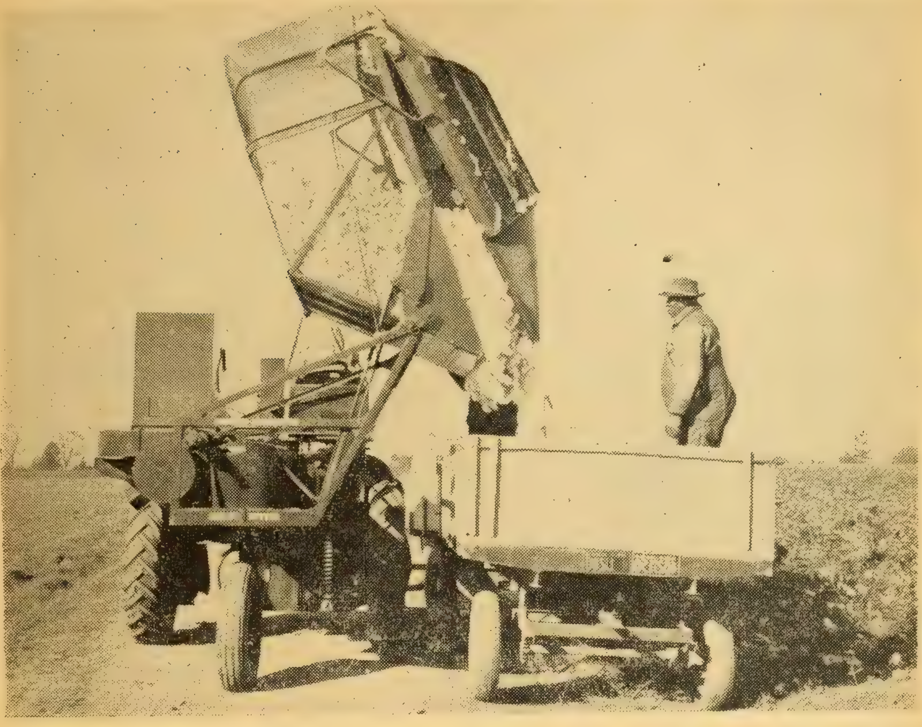

Figure 1. Unloading harvested cotton from mechanical harvester.

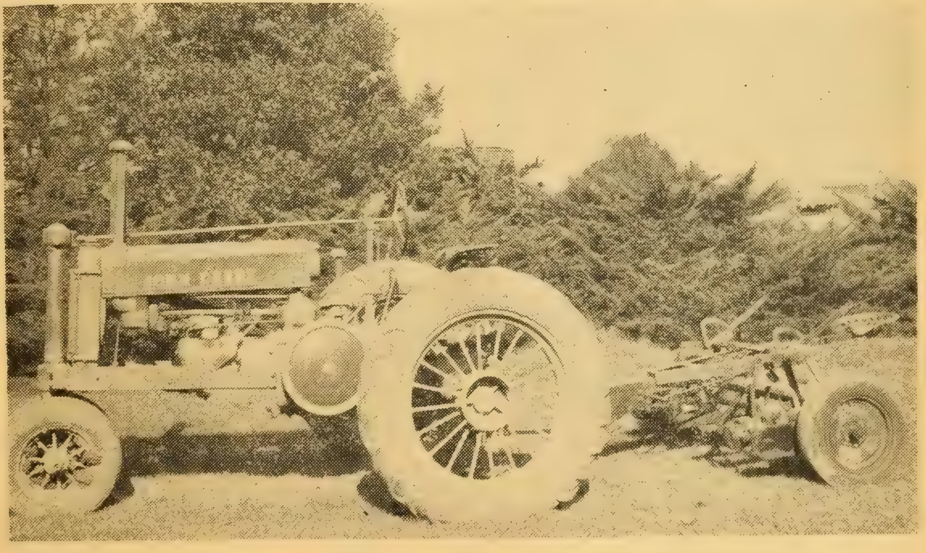

Figure 2. 2-row Dixie cotton chopper.

Table 1. Yield, moisture, and foreign matter content of seed cotton; classer's staple length and grade; fibrograph upper half mean, mean length, uniformity ratio; Pressley index and moisture percent of lint as affected by methods of cultivation and harvesting.

	Seed cotton			Lint						
						Fibrograph				
Treatment	Lbs. per acre	Moisture percent	Foreign matter percent	Staple length 32s	Grade numerical	Upper half mean	Mean length	Uniformity ratio	Presley index	Moisture percent
Drill	1105.8	14.1	6.1	34.0	6.8	0.97	.71	73	7.4	8.0
	*			**	*	**	**			**
Check	1217.6	13.6	6.2	34.9	6.6	1.02	.75	74	7.4	8.5
Defoliated	1180.1	13.4	5.9	34.5	6.6	.98	.72	74	7.5	7.9
		*			**	**				**
Undefoliated	1143.3	14.4	6.5	34.4	6.9	1.00	.74	73	7.4	8.7
Hoed	1190.5	14.2	6.1	34.4	6.8	.99	.73	73	7.4	8.4
Flamed	1132.8	13.5	6.2	34.5	6.7	.99	.73	74	7.4	8.2
Hand picked	1257.4	9.8	3.3	34.4	5.3	.99	.73	74	7.4	7.2
	**	**	**		**			*	*	**
Mach. picked	1066.0	17.9	9.1	34.5	8.2	1.00	.73	73	7.5	9.4
Average	1161.7	13.9	6.2	34.5	6.8	.99	.73	74	7.4	8.3

*Odds 19:1 that difference is significant.
**Odds 99:1 that difference is significant.

severe on drilled cotton, due to a greater number of plants per acre, than for that which was checked.

Although there was a difference in yield between defoliated and undefoliated, also between hoed and flamed plots, these differences were too small to be significant.

Table 2 refers to machine-picked plots, only. Segments of rows, 20 feet in length, were gleaned by hand to determine picker efficiency. More cotton was obtained by hand picking in every comparison. The machine picked a little more efficiently in drilled than in checked cotton. Picker efficiency was probably reduced in this test by the droughty condition of the cotton and by the variety used. Constant attention will have to be given in the future to development of best design of spindle, wetting agents for the spindles, and to varieties best adapted to machine picking.

It has been pointed out above that this cotton grew under droughty conditions and many bolls opened prematurely with hard, undeveloped locks. This type of lock was not picked as readily as mature cotton. In fields of more normal growth, the picking percentage by the machine should be higher.

Seed Cotton Moisture

The moisture content of seed cotton in this experiment was unusually high; particularly is this true of the machine-picked cotton. The picker was new and somewhat more water was necessary in cleaning the picking spindles than was used in later pickings. The moisture content of seed cotton was not significantly

Table 2.—Percent of cotton gleaned behind the cotton picker from 20 feet of row for hoed and flamed, drilled and check, and defoliated and undefoliated cotton.

Tillage and defoliation	Hoe	Flamed	Average	Average drill and check
Drill defoliated	20.2	18.1	19.2	
Drill undefoliated	21.6	22.0	21.8	20.5
Check defoliated	23.2	24.0	23.6	
Check undefoliated	23.5	25.6	24.6	24.1
Average	22.1	22.4	22.3	22.3

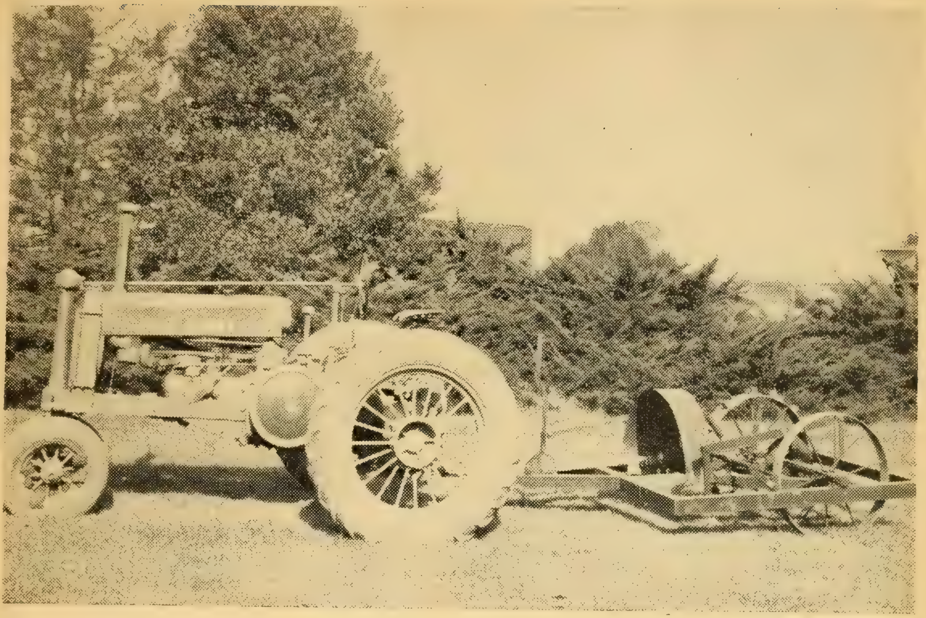

Figure 3. 1-row Finklea chopper.

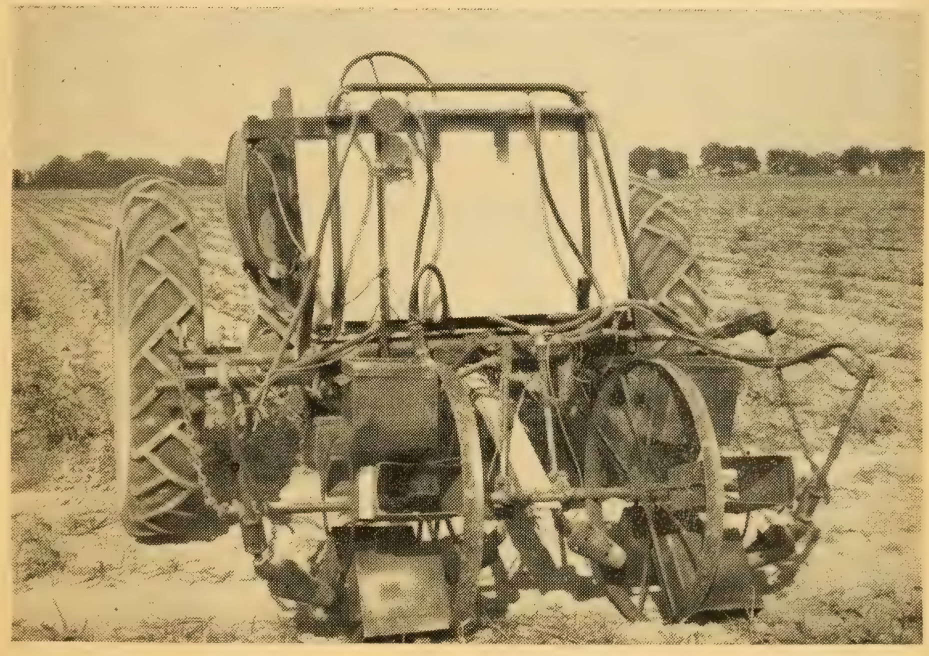

Figure 4. 2-row flame chopper.

different for drilled or checked cotton, or for hoed or flamed, when comparisons are confined to either hand or machine picking.

Defoliation significantly reduced moisture content below that for undefoliated seed cotton. In taking the leaves off with "Aero Cyanamid," transpiration is either stopped or greatly reduced. Bolls open more rapidly and dry faster on defoliated plants, because air and sunlight pass through the plants more rapidly.

Machine picking greatly increased the moisture content of seed cotton, as it is necessary to keep the spindles of the machine moistened at all times while the machine is being operated. The added moisture helps to clean the spindles so that they do not become gummed by juices from the plants and lose their picking aggressiveness.

Foreign-Matter Content

Foreign-matter content of seed cotton was affected only by methods of picking. Machine picking greatly increased the foreign-matter content, as reflected in commercial grade of lint and amount of waste in spinning, which will be discussed later. Table 3 shows a significant interaction between defoliation and picking. Hand picking of defoliated cotton gives a higher foreign-matter content than hand picking of undefoliated cotton, while the reverse is found for machine picking. This would seem to be due to relative amounts of dried and green leaves taken in the two methods of picking. Dried leaves which hang in the plant following defoliation are the only hazard to hand picking, while both green and dried leaves affect machine picking. Defoliation probably increases the amount of dried leaves for both hand and machine picking, but it materially reduces the total of green and dried leaves taken by the machine. Defoliation may in this way tend to reduce the grade on the one hand, and increase it on the other; completeness of defoliation would seem to be the controlling factor.

Staple Length and Grade

A difference in staple length existed only between drilled and checked cotton, as given in table 1. This was accompanied by significantly greater yields from checked plots, and correlates with greater vegetative vigor observed for checked cotton than for drilled cotton, for this season and location.

The numerical grade is the average for two commercial classers. The grades were given numerical values so they could be averaged and statistically analyzed. The following tabulation gives the numerical assignment to grade:

3. Good middling
4. Strict middling
5. Middling
6. Strict low middling
7. Low middling
8. Strict good ordinary
9. Good ordinary
10. Ordinary

Although the grade for checked was superior to the grade for drilled cotton, the difference was small and was probably due to causes which would be less significant under more normal seasonal conditions and farm practices. Checked cotton was more vigorous during the dry weather and set bolls for a short period after the drilled cotton had stopped fruiting, therefore was later in opening. Thus, the checked cotton was exposed to the weather for a somewhat shorter period.

Table 3. Percentage of foreign matter in hand- and machine-picked cotton from defoliated and undefoliated plots.

	Hand picked	Machine picked	Average
Defoliated	3.7	8.2	6.0
Undefoliated	2.9	10.0	6.5
Average	3.3	9.1	6.2

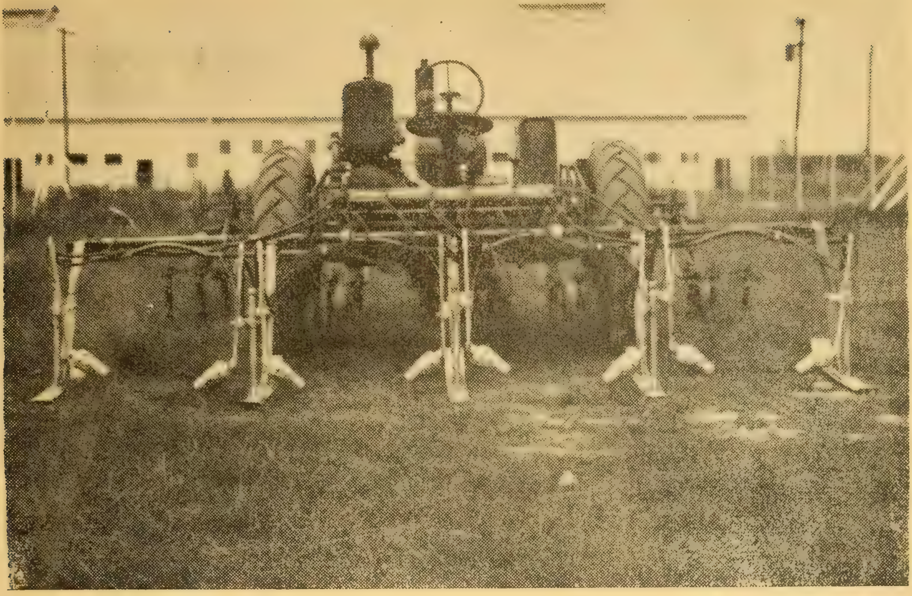

Figure 5. The 4-row flame cultivator and 4-row cultivator.

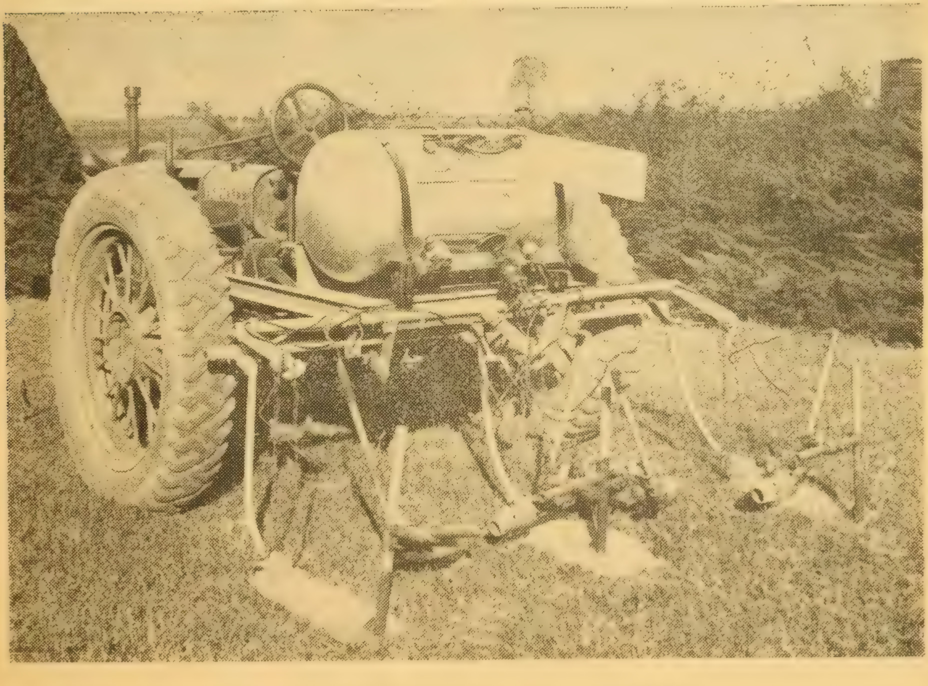

Figure 6. "Bottled Gas" 2-row flame cultivator.

Defoliated cotton was on the average 0.3 of one grade superior to undefoliated cotton. This improvement was entirely due to machine picking as will be pointed out later.

Machine-picked cotton averaged 2.9 grades below hand-picked cotton. The grade of machine-picked cotton was controlled by leaf or foreign-matter content, and gives an interaction picture similar to that of foreign matter (table 3).

Table 4 shows a significant interaction for grade, as affected by picking and defoliation. Defoliation reduced hand-picked cotton by 0.1 of a grade, an amount not significant; but defoliation improved hand-picked cotton by 0.7 of a grade, and an amount which is highly significant.

Lint Quality

Fibrograph data for lint, as shown in table 1, is a measure of staple length and uniformity. Following is a quotation explaining the meaning of the several fiber measurements made (4):

> "**Fiber-length (fibrograph).** These tests provide measures of fiber length as determined by the fibrograph which is a photo-electric device for measuring the length and length distribution of the fibers in a sample of cotton. The **'upper half mean length,'** as determined by this instrument, provides a measure of the average length of all fibers longer than the mean length, expressed in terms of decimal fractions of an inch. Although the 'upper half mean length' is closely related to the classer's designation of staple length, it may vary from that value because of fiber characteristics other than length which may be taken into account by the classer. **'Mean length'** is the average length of all fibers in the sample, excluding those shorter than ¼ inch.
>
> "The **'uniformity ratio'** expresses the relation between the mean length of the fibers and the upper half mean length, and provides a relative measure of the length uniformity of the fibers. The larger the figure reported, the more uniform the fiber length. For practical purposes, comparisons between samples may be made according to the following descriptive designations:
>
> **Uniformity ratio**
> Above 80—Uniform in fiber length
> 76 - 80—Average uniformity
> 71 - 75—Slightly irregular in fiber length
> 70 and below—Irregular in fiber length
>
> "The uniformity ratio, as determined from fibrograph data, is not strictly comparable with coefficient of variation based on the sorter array. The latter is based on all fibers in the sample, whereas the fibrograph disregards fibers shorter than ¼ inch."

The fibrograph upper-half mean showed checked cotton to be longer than drilled cotton; the cotton classer's data showed the same trend, as pointed out previously. Mean length measurements gave a highly significantly greater value for checked cotton. These points will be discussed further under spinning value.

The uniformity ratio and Pressley index both showed a significant difference between hand- and machine-picked cotton.

The percentage of moisture in lint cotton from drilled plots was below that from checked plots for both hand and machine picking, as shown in table 5. Also, as given in table 6, the percentage of moisture in lint was lower for defoliated than undefoliated plots, for both hand and machine picking. In the case of defoliated, and probably in the case of drilled cotton, the lower moisture content can be explained on the basis of the period of time the cotton had been open when picked.

Seed Studies

Moisture content of seed was reduced by defoliation, and was higher where machine picking was used. The explanation for variations of moisture in seed are the same as those given for variations found in seed cotton.

The second column of table 8 gives the percent of free fatty acid in the cottonseed

Table 4.—Numerical grade of hand- and machine-picked cotton from defoliated and undefoliated cotton

	Hand picked	Machine picked	Average
Defoliated	5.3	7.8	6.6
Undefoliated	5.2	8.5	6.9
Average	5.3	8.2	6.8

Table 5.—Lint moisture percentage of hand and machine picking from drilled and checked cotton

	Hand picked	Machine picked	Average
Drilled cotton	6.8	9.2	8.0
Checked cotton	7.6	9.5	8.6
Average	7.2	9.4	8.3

Table 6.—Lint moisture percentage of hand and machine picking from defoliated and undefoliated cotton

	Hand picked	Machine picked	Average
Defoliated	6.9	8.9	7.9
Undefoliated	7.4	9.9	8.7
Average	7.2	9.4	8.3

Figure 7. Section of U. S. Cotton Fiber Laboratory. Picture furnished by the U. S. Ginning and Fiber Laboratories.

for the four comparisons. The difference found for each comparison is highly significant. Free fatty acid in seed from checked cotton was one percent less than for drilled cotton; this was not due to lower moisture percentage, as there was no difference in seed moisture content. Length of exposure in the field appears to be the only logical explanation of this difference, as the drilled cotton had been open somewhat longer in the field. M. L. Karon and A. M. Altschul (5) show there is a direct relationship between moisture percent, time in storage, and the rate of formation of free fatty acid in cottonseed.

Free fatty acid of seed from undefoliated cotton was higher than from the defoliated. This difference may be attributed to the higher moisture content of the seed from undefoliated plants. Hand-picked cotton was lower in free fatty acid than machine--picked cotton; this would again seem to be a moisture factor. Seed from flamed cotton was lower in free

Table 7. Picker and card waste, neps per square inch, strength and appearance grade of yarn for 22s, 44s, and 60s yarn as obtained from spinning test

Treatment	Picker and card	Neps per sq. in.	Yarn strength			Yarn appearance grade		
			22s	44s	60s	22s	44s	60s
Drill	15.57	44	109.7	45.3	29.6	6.8	8.0	8.1
Check	15.10	41	112.8	46.2	30.5	6.8	7.9	8.0
Defoliated	14.30	45	110.9	45.6	30.0	6.9	7.9	8.3
Undefoliated	16.40	41	111.6	45.9	30.2	6.8	8.0	7.9
Hoed	15.61	41	111.5	45.8	30.0	7.0	8.0	7.9
Flamed	15.05	44	111.1	45.7	30.1	6.6	7.9	8.3
Hand picked	10.60	43	109.7	44.8	29.4	6.9	7.9	8.3
Machine picked	20.10	42	112.8	46.7	30.7	6.8	8.0	7.9

Table 8. Moisture, ammonia, free fatty acid, and oil percentages of cottonseed as affected by methods of cultivation and harvesting

Treatment	Moisture percent	Free fatty acid percent	Ammonia percent	Oil percent	Grade
Drilled	11.9	2.9 **	3.84	19.8	101.7 **
Checked	11.8	1.9	3.89	19.9	105.9
Defoliated	11.5 *	2.1 **	3.83	19.7	104,0
Undefoliated	12.3	2.7	3.90	20.0	103.6
Hoed	12.1	2.8 **	3.91	19.7	102.1 *
Flamed	11.7	2.0	3.82	19.9	105.5
Hand picked	9.5 **	2.1 **	3.86	19.9	104.8 *
Machine picked	14.3	2.8	3.87	19.8	102.7

*Odds 19:1 that difference is significant.
**Odds 99:1 that difference is significant.

Table 9. Upper half mean, mean length as determined by fibrograph, and Pressley index of cotton gleaned from machine-picked cotton.

Treatment	Upper half mean	Mean length	Pressley index
Drilled	.89	.64	7.9
Checked	.92	.65	7.5
Defoliated	.90	.64	7.7
Undefoliated	.92	.65	7.7
Hoed	.91	.65	7.7
Flamed	.90	.65	7.7
Average	.91	.65	7.7

fatty acid than hoed cotton. Although the moisture percentage of seed, lint, and seed cotton for flamed plots was below that for hoed cotton, the difference in no instance was great enough to reach significance.

When all cases are considered, the differences in moisture contents give the best explanation of the differences in free fatty acid contents. The fact that moisture was applied to the spindles to permit proper functioning of the machine, emphasizes the necessity of immediate drying and ginning of machine-picked cotton. Inability to do this immediately for large numbers of small lots of experimental cotton, with consequent deterioration of seed and lint, served to reduce quality of both by an undetermined amount. The lowering of grade of lint and seed due to machine picking may, therefore, be greater in these tests than those found in commercial practice.

The oil content of the seed was not affected by any of the comparisons made.

Seed from checked plots had a considerably higher grade than those from drilled cotton; this grade difference is in keeping with the free fatty acid difference involved. Although there was a grade difference between defoliated and undefoliated cotton, it was not enough to be significant. However, there appears to be some reason to believe that defoliation may improve seed grade if applied at the proper age of plants. This argument is substantiated by the significantly lower free fatty acid and moisture content of seed from defoliated cotton.

Flaming significantly improved the grade of seed as compared with hoeing. This is largely due to lower free fatty acid content of the seed.

Machine picking significantly reduced the grade of seed. Higher moisture and higher free fatty acid contents were the factors which contributed to the lowering of grade.

Spinning Data

Table 7 gives the spinning data for the four direct comparisons made in the experiment. Waste removed by picker and card was very high in all samples of this test. As was pointed out above, this cotton was grown under drought conditions. There were more dead leaves lodged in the plants than would be normally expected, as defoliation is difficult to accomplish under such conditions, and dead leaves in the plants add greatly to the foreign matter of the lint of either hand- or machine-picked cotton.

The picker and card waste for machine-picked cotton was approximately double that of hand-picked, and was higher than in previous tests. The following tabulation is taken from Delta Experiment Station Service Sheet No. 364.

	Undefoliated	Defoliated
Picker and card waste:		
Hand picked	10.26	10.74
Machine picked	15.72	13.91

Although there was a slight difference in neps per square inch, those differences are not considered significant.

Yarn strength for checked cotton was stronger than for drilled cotton for 20s, 44s, and 60s, and the "appearance" for all three sizes was equal. Greater strength of checked cotton was probably due to the extra length, as indicated by the classer's staple length, fibrograph upper half mean, and mean length. Defoliation and flaming apparently did not affect the spinning value of the lint.

Machine-picked cotton produced a stronger yarn than hand-picked cotton. The Pressley index indicated a slightly stronger fiber, with no difference in staple length for machine-picked cotton as compared with hand-picked. The removal of the picker and card waste may have taken out short fibers which would help to account for additional strength. Also, about 22 percent (table 2) of the cotton was left in the field by the mechanical picker. Underdeveloped, immature locks were included in the cotton left, which gave shorter but slightly stronger fiber. The fibrograph measurement of upper half mean of machine- and hand-picked cotton was 1.00 and 0.99 (table 1) as compared with 0.91 (table 9) for the gleaning behind the machine. The Pressley index for machine-picked cotton was 7.5 as compared with 7.7 for the gleanings. This staple length difference was equal to about 3/32 of an inch and greatly influenced the spinning value of the cotton. The additional Pressley strength of the gleaning was not sufficient to affect the reduced length, both of which affect spinning value.

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Time Activities
in
Homemaking

By

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TIME EXPENDITURES IN HOMEMAKING ACTIVITIES BY WHITE AND NEGRO TOWN FAMILIES

By DOROTHY DICKINS

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In the summer of 1943, 160 white and Negro homemakers residing in Mississippi towns, kept records for one week of how they used their time and the assistance they received in homemaking activities, in connection with a food preparation study to be reported in other bulletins of the Mississippi Agricultural Experiment Station. It is the purpose of this report to show time spent in various homemaking activities by the homemakers and in the families included in this study. To what extent was homemaking a part time job for these groups? What were time costs of various homemaking activities? What are the possibilities for reducing time spent? These are questions with which this report will be concerned.

The large group of young women married during the war and with husbands now returning might profit by studying time expenditures of these homemakers and their families. Such data may assist in helping to decide whether gainful work should be continued now that the new job of homemaking has been assumed.

Time Expenditure Records

Each homemaker was asked to keep a record of activities and assistance in homemaking activities during the week in which food preparation records were being kept. White and Negro home economics teachers supervised record keeping. The same type of schedule and the methods of classification of time developed by the Bureau of Home Economics (now the Bureau of Human Nutrition and Home Economics) in their time studies were used in this study.

Description of Families and Schooling of Homemakers

The families in this study were selected from families included in a survey made in Ackerman, Eupora, and Marks, Mississippi. [The survey included all families in the towns (a) eating meals at home, (b) with a female homemaker, (c) no more than one boarder. Information was secured from 94 percent of the eligible families.] Two groups each of white and Negro families were taken: 80 white families with monthly rent or rental value of house, apartment, or rooms (unfurnished) of $20.00 or less and of $20.01 to $40.00; 80 Negro families with monthly rent or rental value of house, apartment, or rooms (unfurnished) of $7.50 or less and of $7.51 to $20.00. Families with higher housing values were not included in this record sample, since such families comprised only 8 percent of the white and 0.2 percent of the Negro families in the survey from which the sample was taken.

About 40 families in each of the four groups were selected, since the purpose of the record study was to determine some of the factors causing variation in activities, such as socioeconomic status and race. In the survey, 44 percent of the white families had housing values of $20.00 or less, and 48 percent of $20.01 to $40.00, while 62 percent of the Negro families had housing values of $7.50 or less, and 38 percent of $7.51 to $20.00.

The families of white homemakers of this study averaged 3.5 members, of Negroes 3.6 members. Median size of family (the size half way between the largest and smallest) for both whites and Negroes was 3 members. Thirty-nine percent of the families in both white and Negro groups were families in which all members were over 15 years of age. Thirty-five percent of the white families and 28 percent of the Negro families had one or more children 5 years and under, while 26 percent of the white families and 33 percent of the Negro families had no child 5 years or under, but had children 6 to 15 years of age. Eight white families and seven Negro families had children under a year of age. The presence of children, as well as their age, is, of course, an important factor in time expenditures in homemaking activities.

Twenty-six of the 80 white homemakers and six of the 80 Negro homemakers had had college training. Eighteen of the Negro homemakers and one of the white homemakers had had six grades of schooling or less. The fact that there were 19 women with such limited schooling willing to cooperate in this study was because other members of their families with more schooling were willing to keep the records for them or because they had continued their education by reading. The median grade completed by the white homemakers of this study was the twelfth, and by Negro homemakers the eighth. Median grade of school completed by white homemakers in the survey was likewise the twelfth. However, Negro homemakers in the survey had completed a median of only the sixth grade.

How Homemakers Used Their Time

In table 1 is shown the average time during one week given to work and to personal activities by white and Negro homemakers in families of varying housing values. The most interesting thing about this table is not the differences in the use of time (white homemakers averaged somewhat less time in work activities, more time in personal activities than did Negro homemakers), but the similarities in the use of time. About one-third of the 168-hour week was devoted to work by all four groups, about four-tenths to sleep and rest, and the remainder to other personal activities.

Work included homemaking, food production for home use, and gainful work. As used in this discussion, the term homemaking applies to activities connected with housekeeping and management of the homemaker's own household and the care of its members, together with going to places and returning home in connection with homemaking activities. Food production included activities done for homemaker's own household use, such as milking, care of milk, making butter, care of poultry, care of garden, gathering vegetables. Food preservation, such as canning, preserving, and pickling, was classified as a homemaking activity, not as food production. Gainful work was work for which the homemaker received pay and help which the homemaker gave to members of her household in work for which they received pay. Some of the gainful work engaged in by homemakers during the week of the study was clerical work, cleaning work, teaching music, laundry work, sewing, helping husband at store, milking, picking cotton, and beauty parlor work.

All homemakers of this study spent some time in homemaking activities. All white homemakers except 17 (9 in the $20.00 and under housing group and 8 in the $20.01 to $40.00 housing group), and all Negro homemakers except 13 (7 in the $7.50 and under housing group and 6 in the $7.51 to $20.00 housing group), spent sometime in food production. Of those homemakers engaging in food production, time spent per week varied from 15 minutes to 29 hours.

Twenty-nine percent of the white homemakers and 53 percent of the Negro homemakers spent some time in gainful activities during the study week. Time spent in this way ranged from 30 minutes to 47 hours and 45 minutes. Two homemakers, one white and one Negro, spent this maximum amount of time in gainful work.

Homemakers in all four groups spent more time in food homemaking activities than in any other type of work activities (table 1). There was little difference in time expenditure for food

Table 1. How 160 white and Negro town homemakers in Mississippi used their time during the study week classified by housing value.*

Item	White homemakers				Negro homemakers			
	In families with housing value $20.00 and under		In families with housing value $20.01 to $40.00		In families with housing value $7.50 and under		In families with housing value $7.51 to $20.00	
	Av. time per homemaker		Av. time per homemaker		Av. time per homemaker		Av. time per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs .	Min.	Hrs.	Min.
Work	58	54	55	24	61	12	61	6
Food homemaking	27	12	26	54	26	30	25	54
Other homemaking	23	6	18	36	20	36	22	12
Food production for home use	4	36	5	30	4	36	5	36
Gainful work	4	12	4	12	9	24	7	18
Personal time	108	36	111	26	106	48	106	30
Sleep and rest	67	18	64	12	71	0	69	0
Leisure	23	36	28	6	18	54	20	24
Personal care of self**	17	18	19	0	16	42	17	6
Miscellaneous	1	0	0	48	0	36	0	42
Number of homemakers	41		39		39		41	
Median size of family	3		3		3		3	
Proportion of families with adults only***	31.7		46.2		30.8		46.3	
Proportion of families with one or more children 5 yrs. and under	48.8		20.5		28.2		29.3	
Proportion of families with children 6 to 15 yrs. only	19.5		33.3		41.0		24.4	
Number of families with children under 1 yr.	7		1		3		4	

*All records except 5 were kept the summer of 1943. Five white families kept records in the winter. This record keeping was supervised by an experienced home economics club leader.

**Includes a few other personal activities of homemaker.

***With persons of 16 years of age and over only.

homemaking by the four groups of homemakers. Time spent in other homemaking activities took second place, and varied from an average of 18 hours and 36 minutes in the group of white homemakers in families of $20.01 to $40.00 housing value, to 23 hours and 6 minutes in the group of white homemakers in families of $20.00 and under housing value.

Gainful work played a relatively more important role in the work week of the Negro woman than of the white woman, average time expenditures being twice as great. White and Negro cooperators in families of higher housing value spent more time producing food for home use than did white and Negro homemakers in families of lower housing value.

Figure 1 gives the variation in the work period of the four groups of homemakers during the week of the study. As will be noted, the majority of cooperators in every group worked more than 50 hours a week. Seven of the 80 white women and 18 of the 80 Negro women worked 70 hours or more. The minimum time spent in work activities by a cooperator of this study was 27 hours and 48 minutes, the maximum time 83 hours. The family in which the homemaker spent so little working time was a white family of husband and wife only. The wife did not have gainful work nor did she

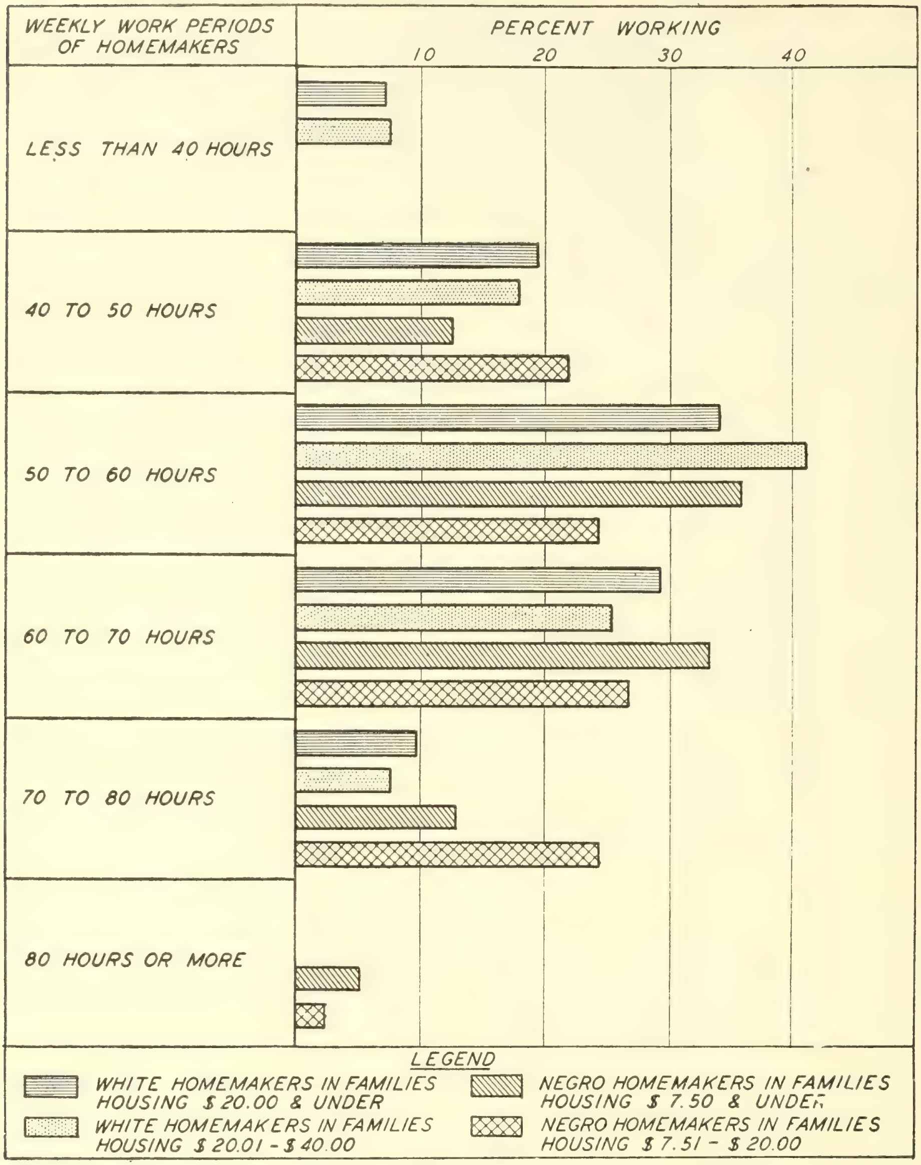

Figure 1. Variation in weekly work period of white and Negro town homemakers of Mississippi.

spend any time in food production. The family in which the homemaker spent 83 hours working was likewise a family of husband and wife only. It was a Negro family in which the wife spent 42 hours and 15 minutes in gainful work.

In some of the time given to activities classified as personal, the homemaker was not entirely free from homemaking responsibilities, as for instance, she may have been reading and at the same time giving some attention to children. In fact, some of these homemakers scarcely knew the meaning of "free" time. Personal activities included sleep and rest, leisure activities, personal care of self, and any other personal activities.

About one-fifth of the personal time of women in this study was devoted to leisure activities (table 1). Sleep and rest took about 65 percent of this personal time, and personal care of self the remainder. White homemakers in families of $20.01 to $40.00 housing value averaged less time in sleep and rest and more in leisure and personal care of self; Negro homemakers in families of $7.50 and under housing value averaged more time in sleep and rest and less in leisure and personal care of self activities. The group averaging the greatest number of hours in work activities average the smallest number of hours in leisure time activities, and the group averaging the smallest number of hours in work activities averaged the greatest number of hours in leisure time activities. However, the differences were small.

All groups of homemakers averaged more time in informal social life (that is, talking with members of their own families, with neighbors, relatives and other friends in their homes or visiting in homes of neighbors, relatives or friends, or visiting in town) than in any other type of leisure activity. A great deal of the visiting, since it was summer time, occurred on the front porch, or out in the yard (table 2).

Reading was of next importance as a leisure time activity for white cooperators, "meetings and study" for Negro cooperators. Several Negro homemakers attended all day church meetings. Several attended rather frequently "protracted meetings" that happened to be going on at the time of this study. This accounts for their greater time expenditures in "meetings and study" than is the case of the white groups.

"Meetings and study" was almost altogether time spent in church activities. The fact that records were kept during summer when school and a number of other organized groups do not ordinarily hold meetings may account for so few of these activities appearing on the records.

From a study of activities of homemakers, it is quite evident that the church

Table 2. Average time spent during one week in leisure time activities by white and Negro town homemakers of Mississippi classified by housing value.

Leisure activity	White homemakers				Negro homemakers			
	In families with housing value $20.00 and under		In families with housing value $20.01 to $40.00		In families with housing value $7.50 and under		In families with housing value $7.51 to $20.00	
	Av. time per homemaker		Av. time per homemaker		Av. time per homemaker		Av. time per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Reading	3	6	5	12	1	24	1	30
Radio	1	4	1	42	1	5	0	44
Correspondence, telephoning	1	16	1	40	0	34	0	58
Informal social life	9	53	10	17	7	38	7	47
Social affairs, entertainments	0	39	0	54	0	30	0	43
Movie	1	24	1	0	0	30	0	51
Meetings and study	1	20	2	18	3	27	3	50
Work of organizations	0	22	1	23	0	27	0	32
Assistance given persons outside family	0	50	0	30	0	28	0	55
All other and unspecified	3	39	3	15	2	55	2	38
Number of homemakers	41		39		39		41	

is a leading social institution. Included in church activities by homemakers of this study were socials as well as meetings. Among church activities listed were preaching service, Sunday School, prayer meeting, women's missionary society, young people's unions, church conventions, business women's circle, baptizing, ice cream suppers, fish frys, and choir rehearals. Work for organizations, in all cases except with the white group of $20.01 to $40.00 housing, was in connection with the church. Several women in this group did Red Cross work.

Reading the newspaper was the type of reading most often mentioned, and listening to the news was the kind of program most often listed in connection with the radio. When homemaking was combined with listening to the radio, as for example, shelling peas and listening to the radio, the homemaker was classified as shelling peas or as sewing.

Included in the "all other and unspecified" leisure time activities are activities such as cooperating in this study, games (such as checkers, rummy, bridge), sports, outings, playing the piano. Only three homemakers, all of them white women, spent time in sports. One went horseback riding with her husband, and two went swimming.

Miscellaneous activities included those appearing on records of cooperators which could be classified neither as homemaking nor as personal activities and included less than 1 percent of the time of the average homemaker.

Homemaking Activities of Homemakers

As will be noted in figure 2, all four groups of cooperating women averaged more time in homemaking than the 40 hours a week now advocated for government and other workers. The 40-hour week for government and other workers does not include, however, time spent in going to and returning from work, a time expenditure homemakers do not have. It would, therefore, seem that time expenditures for homemaking were not on the average excessive. But homemaking did constitute a full time job, especially for white women in the lower value group, and Negro women in the higher housing value group. These were the two groups, as may be recalled, which most often had young children.

The important consideration is, however, not the average homemaking week, but how many homemakers in each group

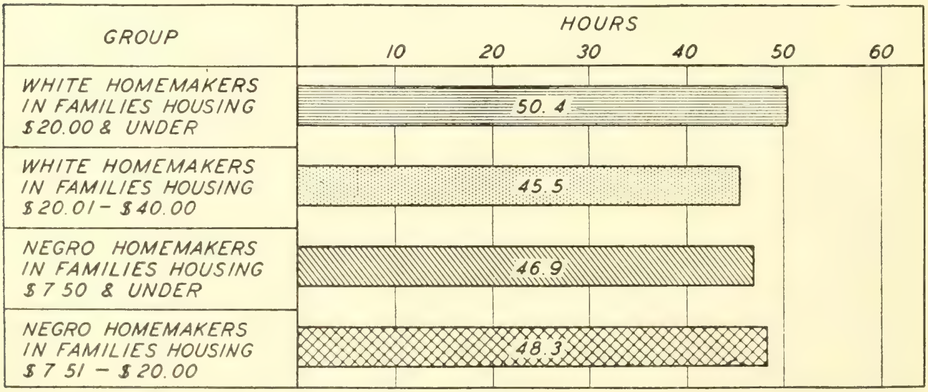

Figure 2. Average time spent per week in homemaking activities by white and Negro women classified by housing value.

Table 3. Variation is time expenditures for homemaking by white and Negro town homemakers of Mississippi on basis of 7-day week and on basis of a 5-day week (Monday through Friday).

Homemaking time expenditures per day	7-day week		5-day week	
	White homemakers	Negro homemakers	White homemakers	Negro homemakers
	Percent	Percent	Percent	Percent
4 hours and under	7.5	3.8	2.5	1.3
4.1 to 6 hours	25.0	28.7	6.3	3.7
6.1 to 8 hours	37.5	45.0	18.7	21.3
8.1 to 10 hours	30.0	20.0	31.3	35.0
Over 10 hours	0	2.5	41.2	38.7
Total	100.0	100.0	100.0	100.0
Number of homemakers	80	80	80	80

exceeded this average. No standard has yet been set for a reasonable work week for the homemaker, but perhaps it would be agreed that more than 56 hours (8 hours a day for 7 days) would be excessive, and that less than 40 hours a week would be unduly low. Within this range of 40 to 56 hours of what might be considered a full-time job, about 38 percent of the white cooperators and 45 percent of the Negro cooperators would fall in this class. Thirty percent of the white cooperators and 2 percent of the Negro cooperators would be classed as overworked homemakers. About one-third in each group would be giving less than full time to homemaking.

A comparison of time expenditures for homemaking during the entire week and during the Monday through Friday period shows how drastically homemaking activities were curtailed over the week-end (table 3). This was done to make possible participation in church activities, visiting or being visited by relatives and friends. Several homemakers spent no time in leisure actvities except over the week-end. There was little, if any, evidence that overworked women used the week-end to catch up with their work.

Food homemaking activities of homemakers. All homemakers of this study spent some time during the record week in food homemaking activities. Time spent per cooperator ranged from 3½ to 50¾ hours. The woman spending the maximum time was in a white family in which there were adults only. She had no assistance in food homemaking activities and canned several foods during the record week.

More than half of time spent in food homemaking activities by women in all four groups was spent in preparation of meals (table 4.) Clearing away after meals took about half the time that preparation for meals did. Preservation of food (including preparation and clearing away) was of next importance with white homemakers. Negro homemakers spent about as much time in food purchasing as they did in food preservation.

Forty-one of the 80 white cooperators and 28 of the 80 Negro cooperators spent some time in food preservation during the week of the study. These records, with the exception of five, were kept during the main canning season. Then, too, canning for home consumption to conserve the national food supply was being stressed for non-farm as well as for farm homemaker. The maximum time spent in food preservation was 22 hours and 45 minutes by a white homemaker. This cooperator devoted practically all of one day and part of two others to canning peaches and apples. At 8:00 a.m. on the first day she started out with washing fruit jars and finished at 8:45 p.m. with 50 quarts of peaches canned. On this day she had had the help of a Negro woman for 8 hours.

As will be noted in table 4, white

Table 4. Average time spent during one week in various food homemaking activities by white and Negro town homemakers of Mississippi classified by housing value.

Food activity	White homemakers				Negro homemakers			
	In families with housing value $20.00 and under		In families with housing value $20.01 to $40.00		In families with housing value $7.50 and under		In families with housing value $7.51 to $20.00	
	Av. time per homemaker		Av. time per homemaker		Av. time per homemaker		Av. time per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Preparing all meals	15	0	14	24	16	6	16	0
Clearing away all meals	7	30	6	54	7	18	7	6
Refreshments for social affairs	0	1	0	18	0	9	0	10
Preservation of food	3	12	3	24	1	36	1	6
Food purchasing and planning*	1	54	1	54	1	30	1	36
Number of homemakers	41		39		39		41	

*Includes going to and returning from town in connection with food buying.

homemakers in the $20.00 and under housing value group averaged more time in preparing and clearing away meals than did white homemakers in the $20.01 to $40.00 housing value group. They had also received somewhat more assistance in these activities. It is probable that the higher housing value group had better equipment and could, therefore, do this work more quickly. Seventy-two percent of them used electric, gas or oil cookstoves, while only 56 percent in the lower housing white group used these facilities. Another factor may have been difference in composition of families; the group requiring more time had the greater percentage of young children. Other explanations for more time by the lower housing group might be differences in menus, in methods of cooking, in kitchen arrangement, in kind and condition of cooking utensils, and in enjoyment of food homemaking activities. These factors will be considered in a future publication.

That Negro women spent more time in preparing meals than did white women can be accounted for in part by the difference in assistance received, the white woman more often receiving it. Another important factor undoubtedly, is the equipment with which they have to work. All Negro cooperators except one used wood and/or coal as cooking fuel.

Other homemaking activities of homemakers. White cooperators with one or more children 5 years of age and under spent on an average 11 hours and 15 minutes in care of children, while white cooperators with children of 6 to 15 years only spent 2 hours and 34 minutes. Time spent by Negro cooperators with young children was 12 hours and 22 minutes, with older children 20 minutes. The fact that more white homemakers in the $20.00 and under housing group had young children than homemakers in the other three groups, therefore, acounts for greater time given by this group to care of children than by the other three groups (table 5). Under care of children is included physical care and such other direct care as teaching, supervising. and amusing.

About one-half of the white homemakers with older children only (6 to 15 years) and three-fourths of the Negro homemakers with older children only, recorded no time in care of children during the week of the study. Need for care of older children was less, of course, during the summer when these records were kept, since the children were not going to school. Then, too, much of the child care of older children is incidental to other tasks. A part of this care was undoubtedly classified as a leisure time activity of the homemaker (perhaps as "informal social life").

All four groups of homemakers averaged one-half hour or more in care of others (table 5). "Others" was in most cases their husband, and care included activities such as assembling husband's clothing, taking dinner to his place of business, and nursing him during illness.

Laundering was "the other homemaking activity" that consumed the most time of Negro cooperators (table 5). Average time spent in daily and weekly cleaning by the white cooperator was greater than average time spent in laundering. The majority of white women either hired a woman to assist in laundry work or sent clothing and household textiles away from home to be laundered. Even so, during summer weather when most of these records were kept, the heavy demand for fresh garments usually necessitated a certain amount of laundry work on the part of the homemaker. Only six of the 80 white homemakers spent no time in laundry work during the week of the study. One of these women was in the $20.00 and under housing value group, and five were in the $20.01 to $40.00 housing group. One factor leading to greater average expenditures in laundering by white women in the $20.00 and under housing group than in the $20.01 to $40.00 housing group, was that the families in the former group had more young children. One Negro cooperator

Table 5. Average time spent during one week in various other homemaking activities by white and Negro town homemakers of Mississippi classified by housing value.

Other homemaking activities	White homemakers				Negro homemakers			
	In families with housing value $20.00 and under		In families with housing value $20.01 to $40.00		In families with housing value $7.50 and under		In families with housing value $7.51 to $20.00	
	Av. time per homemaker		Av. time per homemaker		Av. time per homemaker		Av. time per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Care of house and grounds								
Daily and weekly cleaning	5	30	5	18	4	36	4	48
Work in yard, care of flowers	0	24	0	30	0	30	0	24
Repair and upkeep of house and equipment	0	7	0	56	0	18	0	7
Making fires, getting wood and coal, cutting wood, getting water	0	27	0	6	1	42	1	48
All other (special cleaning, killing insects)	0	7	0	12	0	8	0	6
Laundering	5	18	3	16	6	24	6	18
Sewing, mending								
Care of clothing and fancy work	3	14	3	18	1	42	2	29
Care of members								
Care of children	6	18	2	16	3	36	3	42
Care of others	0	30	0	48	0	30	1	3
Managerial								
Purchasing and planning other goods	0	48	0	48	0	30	1	0
Other managerial activities	0	1	0	6	0	1	0	0
All other	0	26	1	7	0	44	0	32
Number of homemakers	41		39		39		41	

in the $7.50 and under housing group and two in the $7.51 to $20.00 housing group recorded no time in laundry work during the study.

Time spent in daily and weekly cleaning averaged more than five hours a week for white homemakers and more than four hours for Negro homemakers. Three white women and four Negro women devoted no time during the week to activities in this category. Daily and weekly cleaning included cleaning and straightening in connection with the house itself, such as making beds, changing beds, mopping, dusting, vacuum cleaning, and scrubbing bath tub.

That Negro women spent less time than white women in daily and weekly cleaning was not because they had more help. Average assistance in daily and weekly cleaning was for white cooperators 3 hours and 40 minutes; for Negro cooperators 1 hour and 26 minutes. Difference in time expenditures in daily and weekly cleaning of the white and Negro group may be accounted for in part by smaller houses of the Negro. There may have been a difference in standards of cleanliness in the two groups.

The homemaking activities which included sewing, mending, care of clothing, and fancy work were of fourth importance to all groups of homemakers except white homemakers from families of $20.01 to $40.00 housing value. They were second in importance to these (table 5). Thirty-two and 30 percent of the lower housing value white and Negro cooperators, respectively, did not spend any time in these activities; 21 and 24 percent of the higher housing value white and Negro cooperators did not spend any time. Negro women spent more time in mending than did white women. Only six women spent time in "fancy work" for the family.

Homemakers averaged from one-half hour to one hour in purchasing and planning for goods other than food (table 5). Included in these activities is time spent going and returning in connection with purchasing, since such time is generally a necessary part of purchasing.

Effect of Gainful Work on Homemaker's Use of Time

Gainful work seemed to reduce time spent in homemaking activities more than it did time spent in personal activities (table 6). Gainful workers received more assistance in homemaking activities than did non-gainful workers, but the extra assistance they received was less than the extra time in homemaking activities of non-gainful workers. Homemakers with gainful work less often had young children and, therefore, their homemaking time requirements were less. However, composition of the family the same, it seems that somewhat less time was being spent in homemaking activities in homes of gainfully employed women. Were their homemaking standards lower or their equipment superior? Had they found short-cuts that might well be adopted by the non-gainful homemaker household? Were they more efficient workers? Had making or doing it in the home been replaced to a greater extent with buying it on the market? All of these are questions worth consideration. "Some Contrasts in the Levels of Living of Women Engaged in Farm, Textile Mill, and Garment Plant Work," a Mississippi Agricultural Experiment Station bulletin by the writer, gives some information on few of them. More information is needed on how the gainful worker homemaker and her family do manage.

About twice as many in the gainful-worker-homemaker group contained children 6 to 15 years old than in the non-gainful-worker-homemaker group. Evidently, pressure for additional income was great in such families. Then, too, older children require relatively little actual physical care from their mothers.

Gainful employment of the white wom-

Table 6. How white and Negro homemakers of Mississippi without gainful work and with more than 8 hours of gainful work used their time during the study week.

Item	White homemakers				Negro homemakers			
	No gainful work		More than 8 hrs. gainful work		No gainful work		More than 8 hrs. gainful work	
	Av. time per homemaker		Av. time per homemaker		Av. time per homemaker		Av. time per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Work								
Food homemaking	28	29	22	32	27	12	22	36
Other homemaking	23	34	16	31	23	30	16	10
Food production for home use	5	4	3	21	6	24	3	53
Gainful work	0	0	17	45	0	0	21	40
Personal time								
Sleep and rest	66	26	64	5	72	0	67	30
Leisure	25	38	24	36	21	6	19	23
Personal care of self	18	18	17	56	17	0	16	30
Miscellaneous	0	39	1	17	0	51	0	17
Assistance received in homemaking activities per week per homemaker	15	38	20	45	9	54	13	58
Percent families sending out laundry	47.4		47.1		0		0	
Number of homemakers*	57		17		38		27	
Average size of family	3.5		3.9		3.7		3.3	
Proportion of families with adults only	40.4		29.4		42.1		40.7	
Proportion of families with one or more children 5 yrs. and under	36.8		23.5		34.2		11.1	
Proportion of families with children 6 to 15 years only	22.8		47.1		23.7		48.2	

*Six white homemakers and 15 Negro homemakers spent from 5 hours to 8 hours in gainful work during the study week.

an seemed to affect time expenditures in care of older children more than it did that of younger children. The reverse was the case in Negro families. Older Negro children seemed to get very little care from their mothers, whether gainfully employed or not. The number of cases is, however, small.

In figure 3 the average number of hours per week spent in three types of activities by white and Negro homemakers in the non-gainful and gainful worker group are shown. Of the three activities listed—food homemaking, other homemaking, and leisure—time expenditures in other homemaking seemed most affected by gainful work. The gainful-worker-homemaker spent about 7 hours a week less than the non-gainful worker-homemaker on such activities.

Set Time for Doing Tasks

To what extent did homemakers of this study have a set time for doing household tasks? An answer to this question is especially important to home economists who are desirous of assisting homemakers to plan more effective use of time. Where there is a set time for doing tasks, there would probably be more difficulty in assisting homemakers in their problems of time scheduling. The important consideration is a flexible plan that makes greatest satisfaction to the family for the time used.

In tables 7 and 8 difference between earliest and latest time homemakers start-

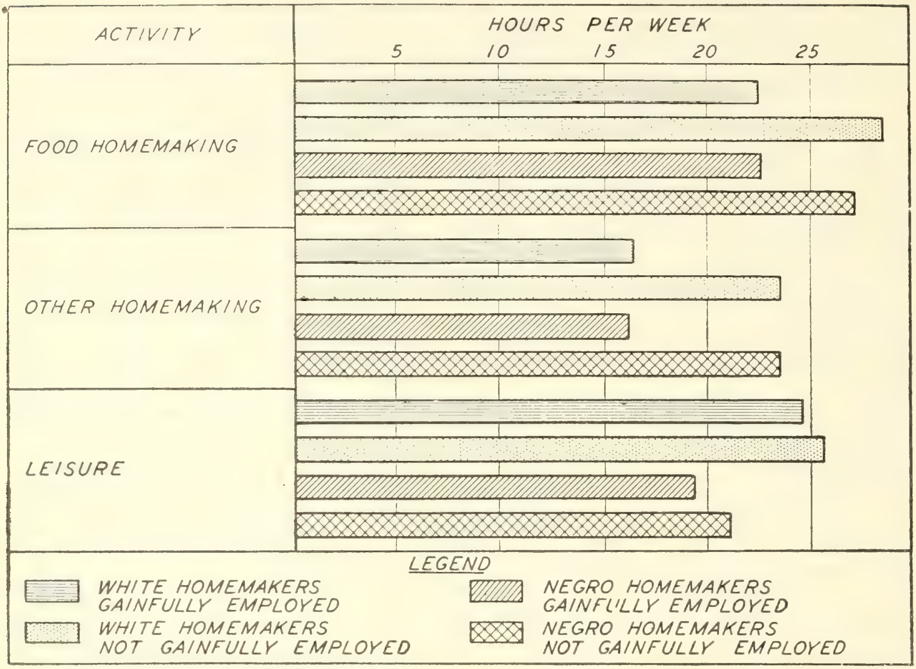

Figure 3. Average number of hours per week spent in food homemaking, other homemaking and leisure activities by white and Negro homemakers with no gainful work and with more than 8 hours gainful work.

ed dinner preparation and cleaning house is given. As will be noted, very few homemakers had a set time for starting these two tasks. Cleaning house was more often done at a set time than was preparing dinner. There was a tendency to have a set time for doing these tasks for homemakers in higher housing groups more often than for homemakers in lower housing groups.

In a few of the homes time of serving dinner varied considerably—one day

Table 7. Difference between earliest and latest time homemakers started dinner preparation (Monday through Friday).

Difference between earliest and latest time homemaker started dinner preparation	In white families		In Negro families	
	With housing value $20.00 and under	With housing value $20.01 to $40.00	With housing value $7.50 and under	With housing value $7.51 to $20.00
	Percent	Percent	Percent	Percent
15 minutes or less	2.6	3.0	0	7.7
16 minutes to 1 hour	39.5	45.5	40.0	46.2
More than 1 hour to 2 hours	34.2	30.3	22.9	15.3
More than 2 hours	23.7	21.2	37.1	30.8
Total	100.0	100.0	100.0	100.0
Number of homemakers	38	33	35	39
Homemaker did not prepare dinner as many as 4 days in 5-day period	3	6	4	2

Table 8. Difference between earliest and latest time homemakers started cleaning house (Monday through Friday).

Difference between earliest and latest time homemaker started to clean house	In white families		In Negro families	
	With housing value $20.00 and under	With housing value $20.01 to $40.00	With housing value $7.50 and under	With housing value $7.51 to $20.00
	Percent	Percent	Percent	Percent
15 minutes or less	10.7	19.2	5.0	9.5
16 minutes to 1 hour	46.5	46.2	65.0	61.9
More than 1 hour to 2 hours	10.7	15.4	20.0	14.3
More than 2 hours	32.1	19.2	10.0	14.3
Total	100.0	100.0	100.0	100.0
Number of homemakers	28	26	20	21
Homemaker did not clean house as many as 4 days in the 5-day period	13	13	19	20

around noon, another day at 4:30 p.m., one day at noon, another at 6:00 or 6:30 p.m. This variation in time of serving accounted for some of the variation of more than two hours in starting preparation. Negro families were less likely to have a set time for eating dinner than white families. However, there was less variation in time of starting to clean house in the Negro than in the white group. But nearly one-half of the Negro homemakers did not clean house as often as four of the five week days and their rceords were not included in this tabulation.

Assistance Received by Homemakers in Homemaking Activities

White homemakers received on an average more assistance in homemaking, but more individual Negro homemakers received help in homemaking. Average number of hours of assistance in homemaking received by white cooperators in the $20.00 and under housing group was 18.2; by those in the $20.01 to $40.00 housing group, 17.2; by Negro cooperators in the $7.50 and under housing group, 12.8; and by those in the $7.51 to $20.00 housing group, 11.2. Fifteen white homemakers and three Negro homemakers had no assistance at all in homemaking.

In table 9 is listed the extent of assistance received by homemakers in various homemaking activities. As will be noted, Negro homemakers received more assistance in care of house, while white homemakers received more assistance in meal preparation and clearing away. Much of the assistance in care of house received by the Negro homemaker was in activities such as cutting wood, bringing in wood and coal, making fires, care of fires, carrying water. It was such activities as these that were responsible for the high proportion of Negro homemakers receiving some assistance in homemaking activities. Oftentimes these were the only kinds of assistance they received.

Negro as well as white cooperators more often had assistance in clearing away meals than in actual preparation of meals. Somewhat more than one-half of the white and Negro homemakers (53 and 51 percent, respectively) had assistance in preparation of meals. Sixty-eight percent of the white cooperators and 59 percent of the Negro cooperators had assistance in clearing away meals.

White homemakers had more assistance in laundering than Negro homemakers (table 9). This was because white women often hired laundry work done at home; Negro women did not. However, assistance received in laundering shown in table 9 understates help which the white cooperators actually received, since it does not include time spent in

Table 9. Average number of hours per week assistance in various homemaking activities received by white and Negro homemakers classified by housing value.

Homemaking activity	White homemakers				Negro homemakers			
	In families with housing value $20.00 and under		In families with housing value $20.01 to $40.00		In families with housing value $7.50 and under		In families with housing value $7.51 to $20.00	
	Av. time assistance per homemaker		Av. time assistance per homemaker		Av. time assistance per homemaker		Av. time assistance per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Meal preparation and clearing away	5	25	6	25	2	38	2	46
Care of house	4	48	5	14	5	9	4	36
Laundering	2	2	2	13	1	49	1	13
Sewing, mending	0	3	0	32	0	34	0	11
Care of members	5	45	2	0	2	44	2	4
Managerial	0	13	0	11	0	22	0	16
All other	0	49	1	25	0	24	0	11
Number of homemakers	41		39		39		41	

laundering clothing and household textiles sent outside the home. Thirty-nine of the 80 white cooperators sent laundry out. No Negro cooperator did so (table 10).

Very few homemakers received help with sewing and mending or with managerial activities (table 9). Assistance in managerial activities was for the most part food purchasing. More Negro than white children shopped for their mothers. Assistance in "all other" was largely assistance in food preservation.

White homemakers in families in the $20.00 and under housing group had more assistance in care of members, mainly young children, than any other type of assistance. Assistance in meal preparation and clearing away and in care of house was greater for the other three groups. As will be recalled, 20 (or 48.8 percent) of the families in the white

Table 10. Average number of hours per week assistance in food and other homemaking activities received by white and Negro homemakers from various persons, classified by housing value.

Homemaking activity and person giving assistance	White homemakers				Negro homemakers			
	In families with housing value $20.00 and under		In families with housing value $20.01 to $40.00		In families with housing value $7.50 and under		In families with housing value $7.51 to $20.00	
	Av. time assistance per homemaker		Av. time assistance per homemaker		Av. time assistance per homemaker		Av. time assistance per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Food homemaking activities								
Husband	0	36	0	5	0	24	0	24
Children	1	48	2	16	2	6	1	26
Hired help	1	48	5	24	0	0	0	0
Others	2	12	0	1	0	48	1	24
Other homemaking activities								
Husband	1	12	0	30	2	42	1	24
Children	4	12	4	24	5	24	5	5
Hired help	4	42	4	24	0	0	0	0
Others	2	4	0	36	1	35	1	36
Number of families sending laundry out	14		25		0		0	
Number of homemakers	41		39		39		41	

group with housing $20.00 and under had one or more children 5 years of age and under. Two of these families hired a small Negro girl to play with and look after small children.

Children were the main source of assistance in homemaking activities to Negro women, while hired help was more important to white women, especially in families with housing of $20.01 to $40.00 (table 10). Assistance from children corresponded with presence of older children. The $7.50 and under housing group of Negroes had more families with children 6 to 15 years only than any other group, and they averaged from 7 to 8 hours assistance in homemaking activities from children. The $20.00 and under housing group of whites had fewer families with children 6 to 15 years only and they averaged slightly less than 6 hours assistance in homemaking activities from children.

Husbands in both white and Negro families of low housing value averaged about twice as much assistance in homemaking activities as those in families of higher housing value. Principal homemaking tasks in which husbands assisted were: care of children, getting in wood, carrying water, making fires, and care of lawn.

Thirty-two percent of the white homemakers in families with housing $20.00 and under, and 51 percent of the white homemakers in families with housing $20.01 to $40.00, hired some one to assist them in homemaking activities during the week of the study. Hired workers in 16 of the 33 families hiring workers during the study week were day or hour laborers. In 17 families, workers were hired on a weekly basis. Usually these regular workers were Negro women, but not always so. One homemaker had a hired man who was responsible for indoor work, such as washing dishes and cleaning. In one case, a 12-year-old boy was used. Several cooperators had little Negro girls 10 or 12 years of age, who cared for the children, assisted in dishwashing and cleaning.

The help hired to assist in homemaking activities at the time of this study was undoubtedly less than ordinary, since the study was made in the wartime period during which many workers in domestic service had gone into other lines of work or because of income received by other family members or from the government made gainful work less necessary.

The relation of number in family and of type of family to the amount of assistance received by homemaker in homemaking activities is shown in tables 11 and 12. Assistance received by homemaker in white and Negro families with

Table 11. Relation of number in family to assistance received per week in homemaking activities by homemaker

Hours assistance received per week by homemakers	White homemakers			Negro homemakers		
	2-member families	3- and 4-member families	More than families 4-member	2-member families	3- and 4-member families	More than 4-member families
	Percent	Percent	Percent	Percent	Percent	Percent
None	40.9	11.4	7.1	13.6	0	0
5 hrs. and under	27.4	13.6	0	68.2	26.3	5.0
5.1 to 10 hours	0	13.6	14.3	13.6	26.3	10.0
10.1 to 20 hours	22.5	20.5	21.4	4.6	23.7	25.0
20.1 to 30 hours	9.2	15.9	28.7	0	15.8	50.0
30.1 to 40 hours	0	9.1	7.1	0	2.6	5.0
40.1 to 60 hours	0	9.1	7.1	0	5.3	5.0
60.1 hours and over	0	6.8	14.3	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	22	44	14	22	38	20

Table 12. Relation of type of family to assistance received per week in homemaking activities by homemaker.

Hours assistance received per week by homemakers	White homemakers			Negro homemakers		
	Adults only	One or more children 5 yrs. & under	Children 6-15 yrs. only	Adults only	One or more children 5 yrs. & under	Children 6-15 yrs. only
	Percent	Percent	Percent	Percent	Percent	Percent
None	25.8	14.3	14.3	9.7	0	0
5 hours and under	22.6	10.7	9.5	61.3	8.7	19.2
5.1 to 10 hours	3.2	21.5	4.8	19.4	21.7	15.4
10.1 to 20 hours	19.4	10.7	38.1	6.4	13.1	38.4
20.1 to 30 hours	16.1	10.7	23.8	3.2	39.1	23.1
30.1 to 40 hours	0	10.7	9.5	0	4.3	3.9
40.1 to 60 hours	9.7	7.1	0	0	13.1	0
60.1 hours and over	3.2	14.3	0	0	0	0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	31	28	21	31	23	26

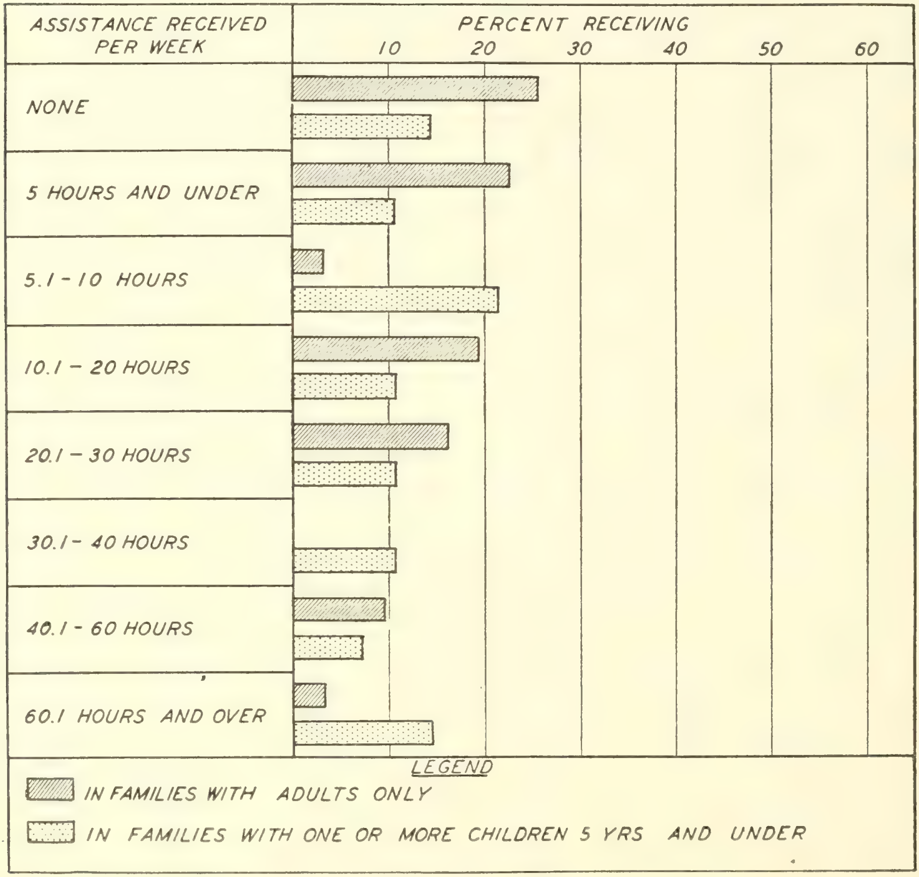

Figure 4. Assistance received per week in homemaking activities by white homemakers in families of adults only in families with one or more children 5 years and under.

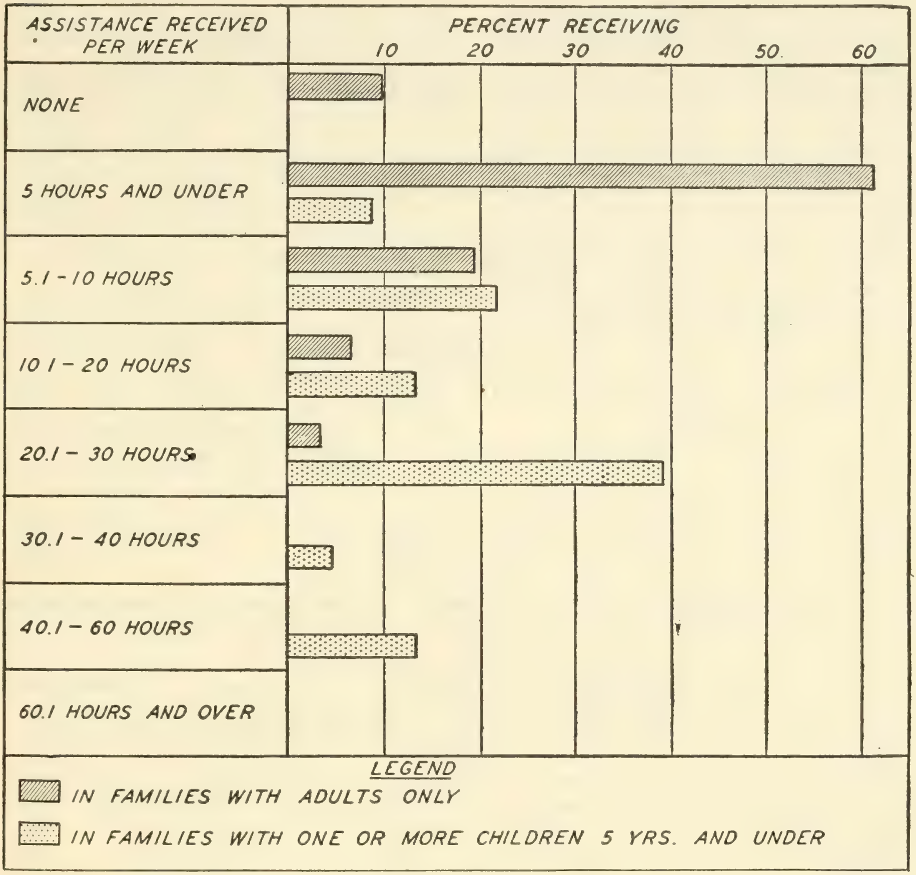

Figure 5. Assistance received per week in homemaking activities by Negro homemakers in families of adults only and in families with one or more children 5 years and under.

adults only, and in white and Negro families with one or more children 5 years and under, are given in figures 4 and 5. As will be noted, homemakers of larger families received considerably more assistance in homemaking than homemakers in smaller families (table 11). Sixty-sight percent of the homemakers in 2-member white families and only 7 percent in more-than-4-member white families received no assistance or less than 5 hours assistance. The percentages for Negro homemakers in the two groups were 82 and 5, respectively.

White homemakers in families of adults only were more likely to receive assistance in homemaking activities than Negro homemakers in families of adults only (table 12). Negro homemakers with children were more likely to receive assistance. However, more white homemakers with children received a large amount of assistance than in the case of Negro homemakers. Homemakers in 21 percent of the white families with one or more children 5 years and under had more than 40 hours assistance in homemaking. The percentage for the Negro group with as much assistance was 13.

Assistance Received by Homemakers in Food Production for Home Use

As will be noted in table 13, assistance in production of food for home use average about three hours in white families; about two and a half hours in Negro families. The husband was the main source of this assitance. However, hired help was almost as important a source for help as was the husband in food production in white families of $20.01 to $40.00 housing value. Children and others were relatively unimportant sources of assistance in all groups.

Total Time on Homemaking Activities

Average number of hours spent on all homemaking activities by all workers per family per week was for white families in the $20.00 and under housing group, 69; for white families in the $20.01 to $40.00 housing group, 63; and for Negro families in both housing groups, 60 hours. If the work week is regarded as 40 hours, then homemaking in these households claimed the full time of one worker and half time of another. Meal preparation and clearing away, care of house, laundering, and care of members were the important homemaking tasks (table 14).

Time expenditures on meal preparation and clearing away were relatively more important in white families of $20.01 to $40.00 housing value, while care of house was relatively more important in Negro families of $7.50 and under housing. One of the main factors in the relatively high time expenditures in care of house by the low housing value Negro group was poor water facilities.

Table 13. Average number of hours per week assistance in food production for home use received by white and Negro homemakers from various persons classified by housing value.

Person giving assistance	White homemakers				Negro homemakers			
	In families with housing value $20.00 and under		In families with housing value $20.01 to $40.00		In families with housing value $7.50 and under		In families with housing value $7.51 to $20.00	
	Av. time assistance per homemaker		Av. time assistance per homemaker		Av. time assistance per homemaker		Av. time assistance per homemaker	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Husband	1	36	1	24	1	42	2	0
Children	0	24	0	6	0	36	0	30
Hired help	0	18	1	20	0	0	0	0
Others	0	30	0	0	0	12	0	12
Number of homemakers	41		39		39		41	

Table 14. Average number of hours spent per week on various homemaking activities by all workers per family classified by race and housing value of family.

Homemaking activity	White homemakers				Negro homemakers			
	Housing value $20.00 and under		Housing value $20.01 to $40.00		Housing value $7.50 and under		Housing value $7.51 to $20.00	
	Average time per family		Average time per family		Average time per family		Average time per family	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Meal preparation and clearing away	27	31	28	10	25	45	26	0
Care of house	11	27	12	19	12	10	11	41
Laundering	7	11	5	31	8	3	7	37
Sewing, mending	3	12	3	17	2	26	2	42
Care of members	12	39	5	47	6	56	6	40
Managerial	2	55	3	14	2	29	3	0
All other	3	44	4	53	2	25	1	57
Number of families	41		39		39		41	

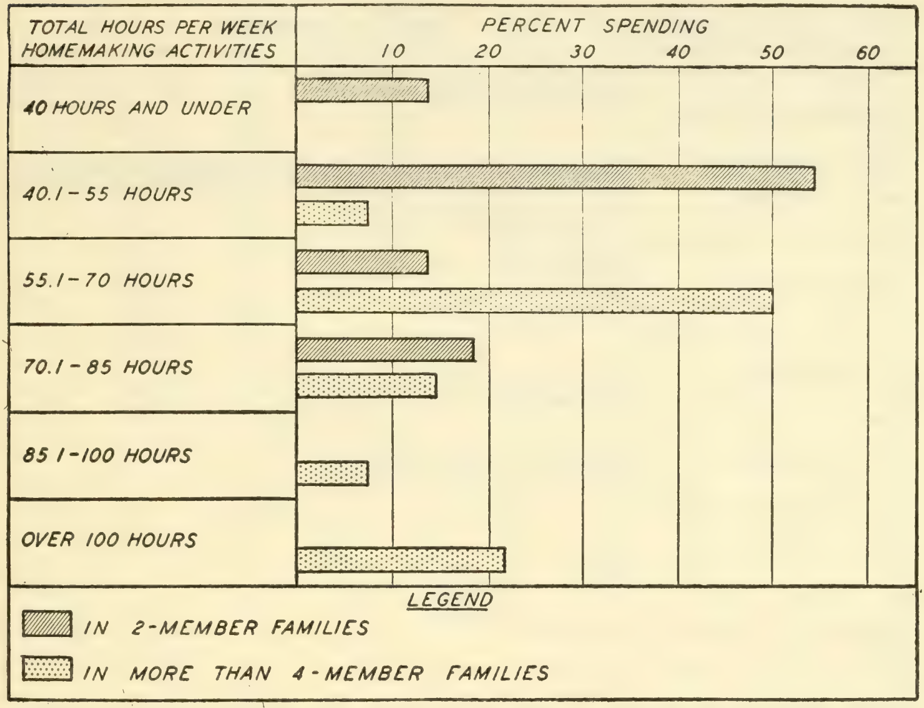

Figure 6. Total time spent per week in homemaking activities in white families of two members and of more than four members.

Only two Negro families had kitchen sinks, 66 white families had kitchen sinks. Most of the Negro families did not have a water supply in the house; a few had no supply on their lot. Time must be spent carrying water and especially when there was no supply on the lot.

That laundering time expenditures in Negro families exceeded those in white families was, as has been previously explained, because a number of white families sent clothing and household textiles outside the home to be laundered. This was nearly twice as often the case with

Table 15. Relation of number in family to total time spent by all workers per week in homemaking activities per family.

Total time spent in homemaking activities per family	White families			Negro families		
	2-member families	3- and 4-member families	More than 4-member families	2-member families	3- and 4-member families	More than 4-member families
	Percent	Percent	Percent	Percent	Percent	Percent
40 hours and under	13.6	0	0	22.7	5.3	0
40.1 to 55 hours	54.6	22.7	7.1	63.7	31.6	25.0
55.1 to 70 hours	13.6	34.1	50.0	13.6	36.8	20.0
70.1 to 85 hours	18.2	27.3	14.3	0	18.4	20.0
85.1 to 100 hours	0	6.8	7.1	0	5.3	30.0
Over 100 hours	0	9.1	21.5	0	2.6	5.0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	22	44	14	22	38	20

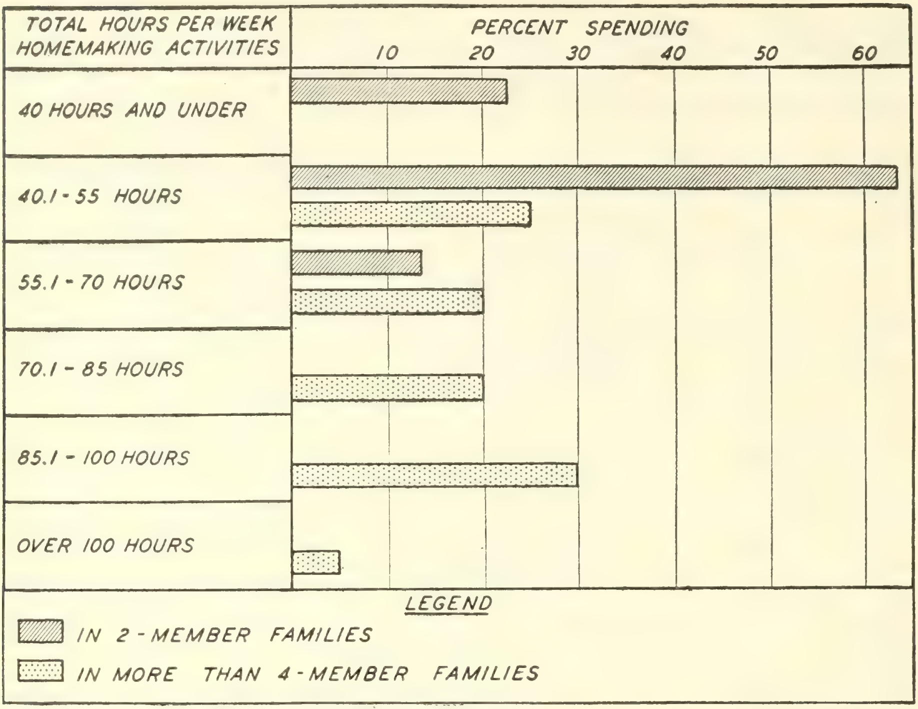

Figure 7. Total time spent per week in homemaking activities in Negro families of two members and of more than four members.

white families in the higher than in the lower housing value group (table 10). Then, too, facilities for laundering were poorer in Negro homes. Only one homemaker, a white woman, was listed as having an electric washing machine, but Negroes had fewer wash tubs, fewer electric irons, a less convenient water supply, than did whites.

As will be noted in figures 6 and 7 and in table 15, total time spent by all workers in homemaking and size of family are related. From 40.1 to 55 hours were spent per week in homemaking activities in the majority of 2-member families, while in the majority of larger families 55.1 to 70 hours were spent. More than 85 hours were not spent in homemaking in a 2-member family, but in 18 percent of the larger families more than 85 hours were spent.

Presence of young children increased greatly the total time spent by all workers in homemaking activities per family (table 16). About one-third of the white and Negro families with one or more children 5 years and under had total homemaking expenditures exceeding 85 hours. Only 4 percent of the families in the other two groups averaged as much time.

Number of Hours Spent in Various Homemaking Activities by Mississippi White and Negro Town Families and by Families in Similar Areas in Two Other Studies.

How do the homemaking time patterns of these Mississippi town families compare with the homemaking time patterns of other groups in similar areas? The only studies of this type known to the writer are two made about 15 years ago,

Table 16. Relation of type of family to total time spent by all workers per week in homemaking activities per family.

Total time spent in homemaking activities per family	White families			Negro families		
	Adults only	One or more children 5 yrs. & under	Children 6 to 15 years only	Adults only	One or more children 5 yrs. & under	Children 6 to 15 years only
	Percent	Percent	Percent	Percent	Percent	Percent
40 hours and under	9.7	0	0	19.3	0	3.8
40.1 to 55 hours	45.2	17.8	19.0	58.2	0	50.0
55.1 to 70 hours	22.5	28.6	47.7	16.1	34.8	30.8
70.1 to 85 hours	19.4	21.4	28.5	3.2	30.4	11.6
85.1 to 100 hours	0	10.7	4.8	3.2	26.1	3.8
Over 100 hours	3.2	21.5	0	0	8.7	0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	31	28	21	31	23	26

Table 17. Average number of hours spent per family per week by all workers on various homemaking activities by the 80 white and the 80 Negro families in this study,* by 61 families in Oregon, and 115 families in a number of states.**

Homemaking activity	Average time spent per family by all workers							
	In Mississippi white families		In Mississippi Negro families		In Oregon families		In families in a no. of states	
	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.	Hrs.	Min.
Meal preparation and clearing away	27	50	25	53	26	28	24	58
Care of house	11	52	11	55	13	6	12	5
Laundering	6	22	7	50	7	44	6	27
Sewing and mending	3	14	2	34	4	41	6	30
Care of members	9	18	6	48	6	5	5	7
Managerial	3	4	2	45	2	42	3	9
All other	4	18	2	11	1	19	2	36
Total	65	58	59	56	62	5	60	52

*In Mississippi, municipalities of from 300 to 2,000 inhabitants are defined as towns. Municipalities of 2,000 or more inhabitants are defined as cities. Villages have less than 300 inhabitants. Families in this study lived in towns of from 1,377 to 1,818, according to 1940 population census.

**Source: Unpublished data compiled by Dr. Margaret G. Reid, "Economics of Household Production," John Wiley & Sons 1934, page 82, which was furnished Dr. Reid by Miss Maud Wilson of Oregon and by the Bureau of Human Nutrition and Home Economics, U. S. Department of Agriculture.

one by Miss Maud Wilson of Oregon families, and the other by Miss Hildegarde Kneeland of the U. S. Bureau of Home Economics, of families in New York, in the Middle West, and in three far Western states.

These studies included families of the "middle class home." Table 17 gives the average time spent per week in various homemaking tasks by all workers per family in each of these two studies and in the Mississippi study. As will be noted, homemaking time patterns of these groups are rather similar. All groups averaged about 60 hours per week in homemaking activities.

The greatest difference in time expenditures in various homemaking tasks in these four groups was the difference in time spent in care of members. Here the Mississippi white family averaged about 9 hours, the Oregon family 6 hours, and the families studied by the Bureau about 5 hours. Information is not available concerning the proportion of Bureau families including young children, but 18 of the 61 Oregon families (30 percent) were "with children under 6 years only." Twenty-four percent of the Mississippi white families and 16 percent of the Mississippi Negro families were of this type. It might be that because the Mississippi white homemaker could hire assistance at low cost, more time could be given to young children. Another possibility is that new standards in child care have resulted in increased time spent in child care.

Some of the differences in time spent in various activities by the four groups of families can be accounted for by the fact that the Mississippi study included for the most part summer-time records, the other studies time records in all seasons. Food preservation classed as an "all other" homemaking activity and occurring for the most part in the summers would account for the higher average expenditure on the part of Mississippi white families. Laundering requires more time in summer (especially in a climate such as Mississippi), but Mississippi white families averaged less time than Oregon and Bureau families because about one-half of them sent some or more of their clothing and household textiles away from home to be laundered. Differences in time expenditures in sewing and mending may be due in part to season. Another factor may be the trend towards less sewing at home.

Summary and Conclusions

In this study, time expenditures during one week of homemakers and of all workers in homemaking activities in 80 white and 80 Negro town families of Mississippi, are analyzed.

Methods which had been worked out by the Bureau of Home Economics for recording and analyzing time expenditures were used. White and Negro home economics teachers supervised record keeping.

Thirty-nine percent of the white homemakers in families in the $20.00 and under housing group and 33 percent in families in the $20.01 to $40.00 housing group spent 60 hours or more in work activities (homemaking activities, food production for home use, and gainful work). Fifty-one percent of the Negro homemakers in families in the $7.50 and under housing group and 54 percent in the $7.51 to $20.00 housing group spent this much time in work activities. Seven percent of the white homemakers in the $20.00 and under housing group and 8 percent in the $20.01 to $40.00 housing group spent less than 40 hours in work activities. No Negro homemaker spent less than 40 hours in work activities.

During the study week 38 percent of the white homemakers and 45 percent of the Negro homemakers spent from 40 to 56 hours in homemaking activities. Thirty percent of the white group and 23 percent of the Negro group spent more time, and about one-third in each group less time. Homemaking activities were curtailed by both white and Negro women on Saturday and Sunday, or over the week-end.

More time was spent by all groups in food homemaking than all other homemaking activities combined. More than half of the time spent in food homemaking activities (preparing all meals, clearing away all meals, refreshments for social affairs, preservation of food, food purchasing and planning) was spent in preparing meals.

Laundering was the "other homemaking activity" that consumed the most time of Negro homemakers. Daily and weekly cleaning took more of the time of the white cooperator. The majority of white women either hired a woman to assist in laundry work or sent clothing and household textiles away from home to be laundered. White homemakers in families of $20.00 and under housing spent more time in care of members than they did in any "other homemaking activity." This was because more homemakers in this group had children of 5 years and under. Homemakers with children 5 years and under averaged about 12 hours a week in care of these children.

Fifty-three percent of the Negro homemakers and 29 percent of the white homemakers spent some time in gainful activities during the study week. Thirty-four percent of the Negro homemakers and 21.5 percent of the white homemakers spent more than 8 hours in such activities. White and Negro homemakers with more than 8 hours gainful work averaged less time in homemaking activities than those without gainful work. This difference in time was not made up by extra assistance in homemaking activities. Some of the difference in time expenditures of the gainful and non-gainful worker groups can be accounted for by a difference in composition of the family, women with young children less often having gainful work.

The gainful-worker-homemaker group contained about twice as many families with children 6 to 15 years only than did the non-gainful-worker-homemaker group.

A tabulation of time of starting two common household tasks—preparing dinner and clearing house—showed that the majority of homemakers did not have a set time for starting such tasks. This was especially true of homemakers in families of lower housing value.

Average number of hours of assistance in homemaking received by white women in the $20.00 and under group was 18.2; by white women in the $20.01 to $40.00 housing group, 17.2; by Negro women in the $7.50 and under housing group, 12.8; and by Negro women in the $7.51 to $20.00 housing group, 11.2.

Children were the main source of assistance in homemaking activities to Negro women, while hired help was more important to white women, especially in families with housing of $20.01 to $40.00. Husbands in both white and Negro families of lower housing value averaged about twice as much assistance in homemaking activities as those in families of higher housing value. Homemakers of larger families received considerably more assistance in homemaking than homemakers in small families. Homemakers in white families of adults only were more likely to receive assistance in homemaking activities than homemakers in Negro families of adults only. Negro homemakers with children were more likely to receive assistance. However, more white homemakers with children received a large amount of assistance than in the case of Negro homemakers.

Average number of hours spent per week on all homemaking activities by all workers per family was, for white families in the $20.00 and under housing group, 69; for white families in the $20.01 to $40.00 housing group, 63; and for Negro families in both housing groups, 60 hours. If the work week is regarded as 40 hours, then homemaking in these households claimed the full time of one worker and half time of another.

Time expenditures on meal preparation and clearing away were relatively more important in white families of $20.01 to $40.00 housing value, while care of house was relatively more important in Negro families of $7.50 and under housing. One of the factors in relatively high time expenditures in care of house of the low housing value Negro group was poor water facilities.

Homemaking time patterns of these Mississippi families were similar to homemaking time patterns of families in similar areas in two other studies made about 15 years ago.

Homemaking was more than a full-time job in the typical family of this study. Thirty percent of the white homemakers and 23 percent of the Negro homemakers averaged more than 56 hours during the study week, or the equivalent of 8 hours a day every day in the week in such activities. Time expended in homemaking must be reduced not only for those who are overburdened, but reduced so that women in families of low socioeconomic status can take some time for gainful work. It must be reduced so that more time can be devoted to children, especially to older children. Among possibilities for reducing homemaking time expenditures are:

1. More efficient methods of doing tasks, especially tasks that consume so much time, such as preparation and clearing away meals, house cleaning, laundering. This means finding the most economical way of performing the tasks, such as eliminating unnecessary steps (a) by planning ahead, (b) by placing equipment and materials in a better place, (c) by using both hands in performing tasks, and (d) by using time-saving equipment.
2. An examination of one's work schedule.
3. Increased use of agencies outside the home, such as the bakery, the commercial laundry, the day nursery. Community and neighborhood clubs have a responsibility in sponsoring such facilities.
4. More effective use of the time of other members of the household.

Planning Use of Time

The study of time expenditures in homemaking of other families can serve only one purpose, that of stimulating thought about one's own homemaking time problems. Use of time is an individual problem, not something that can be borrowed from another. But how others use time can be of value as a check-up on one's own practices.

We might at this point illustrate how time expenditures of others might be used in checking one's own expenditures. My family is, for example, a white family in the $20.01 to $40.00 housing value group. I would, therefore, study tables 1, 2, 4, 5, 9, and 14. I find, for instance, that homemakers in this housing group averaged a little over 21 hours per week in preparing and clearing away meals; that they had 6.5 hours assistance in these activities. I would ask myself: "Is this less time than our family spends?" (If I do not know about the time spent by my family in preparation and clearing away meals, I will find out by keeping a record.) "If it is less time, why? Is our equipment poor? Are we using inefficient methods? Are several complicated dishes often served? Are few ready-prepared or partly prepared foods used? Are food activities and other household tasks combined? Does time of doing task make for time saying?"

"If families of this study are spending more time in food preparation and clearing away than mine, is it because we are using a number of ready-prepared or partly prepared foods; serving a limited variety? Is it because we have low standards? (Maybe we are not rinsing the dishes.)"

Such an analysis as this will help homemakers, see what their real time problems are, or at least give assurance that the family is getting what they want from the use of time. Planning use of time is most important. Every homemaker has the same amount of time—24 hours a day. There are no time-rich, or time-poor homemakers. It is up to each to make her time worthwhile—to make it rich time.

BULLETIN 425 NOVEMBER 1945

Production and Utilization of Silage

IN MISSISSIPPI

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

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PRODUCTION AND UTILIZATION OF SILAGE IN MISSISSIPPI

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Silage production and utilization has long been considered an important, perhaps an essential, practice in successful livestock production.

It is believed that silos date back to the days of ancient Thrace, Carthage, Spain, and Rome, use being made of pits dug as deep as 12 feet and lined with brick, stone, or wood. The modern method of preserving green crops by storage above ground in stone structures known as silos was widely publicized in Germany and France, beginning probably not long after the middle of the nineteenth century; and the first silo of which there is official record in this country was constructed in Maryland in 1876.

The first silos were of stone, but because of lesser spoilage and lower cost, stone construction soon gave way to brick and concrete. In turn, wood construction soon came into common use, especially in areas where lumber was cheap. During comparatively recent years, temporary or still more inexpensive methods of storage have been devised, including "silos" which are little more than wooden boxes of appropriate size, silos of snow fence and waterproofed paper construction, and the trench silos of increasing popularity in the South.

Ensilage materials have undergone a comparable process of evolution. Although a variety of crops was ensiled from the beginning in European countries where corn is not commonly grown, corn was the principle ensilage crop until about the turn of the century in this country, and still is in the high-yielding corn producing states. In the South, however, it was early learned that a much greater tonnage could be secured from a given area of sorghum than from corn, and in Mississippi practically all the silage produced during recent years has been from sorghum.

The silage making process is not limited to a few crops only, but is applicable to a wide variety of crops. Although scientific knowledge is still incomplete, it is believed that any forage plant can be preserved by ensilage, provided the percentages of moisture and sugar or starch are maintained within reasonable bounds. These desirable percentages occur naturally in corn and sorghum of proper maturity, which perhaps accounts for the nearly universal use of these crops until comparatively recent years.

More recently, it has been shown by agricultural experiment stations in many states that a wide variety of crops can be ensiled satisfactorily by simple and inexpensive processes. Thus, moisture content is regulated to the desired level by stage of cutting or by a period of wilting; and necessary starches and sugars, when deficient, may be supplied by the addition of blackstrap molasses, phosphoric acid, or other substances. At present, by careful observance of recommended procedure, satisfactory silage is prepared from numerous crops.

The most recent addition to the field of silage knowledge concerns the content of carotene. Carotene is most abundant in green and growing plants (as well as in the yellow substances such as yellow corn, certain sweetpotatoes, yellow fats, egg yolk, etc.). The first problem of the silage maker is to harvest his crops when carotene is most abundant, provided a too-great sacrifice in yield is not thereby entailed; and the second problem is to preserve the carotene harvested until the ensiled crop is fed.

During a long period of years the Mississippi Agricultural Experiment Station has conducted experiments in the production, processing, and feeding of silage. More lately the research work has concerned the newer phases, including the wide variety of crops suitable for ensiling, treatments necessary, plant-growth stage of cutting, content of carotene, mixtures of legume and non-legume crops, and the building up of protein content by the addition of urea to the silage or the feeding of urea with silage.

This bulletin summarizes and unifies work done by several departments and individual staff members of the experiment station, in an effort to acquaint Mississippi farmers with the new knowledge of silage making, as well as to recall for practical use certain basic principles of silage production and feeding to beef and dairy animals.

SILAGE CROPS AND SILAGE MAKING

Silage is finely chopped, moist or green forage that has been stored and in which a certain amount of fermentation has taken place in the absence of free air. Silage-making enables the saving of feed that would not be eaten in the dry state, as well as feed that would be lost by rain, and preserves 30 percent to 35 percent more of the feeding value of the crop by avoiding weathering losses. Silage is extremely palatable, relished by all classes of cattle and, being succulent, is essentially a substitute for pasture in winter and may be fed in the late summer months when pastures are low. Silage requires less storage room than the same amount of feed in the form of hay or other dry forage. Its removal from the field clears the ground completely for another crop. The storage of a crop as silage rather than as hay eliminates the hazard of fire.

Silage and silage making also has its disadvantages, the chief one being the initial cost for buildings, equipment, and power. It also concentrates the labor for harvesting and preserving into a few days.

The preservation of feed by ensiling is by no means a new process and it is possible to make good silage from any crop that can be fed green. The making of silage from various forage crops may be new to many Mississippi farmers, and it is well to consider that the making of silage from such crops can hardly be considered as an emergency measure altogether. In the broadest sense, it is not practical to make hay while the sun shines and silage while it rains. The crop should be planned for the silo.

Any green forage crop can be made into silage that will keep in good condition without an excessive loss of food nutrients. As a rule, if the forage is palatable and nutritious when it is put into the silo, it will be palatable and nutritious when it is taken out; and if it is poor feed when put into the silo, it will be poor feed when taken out.

Although it is possible to make silage from almost any crop that can be fed green, sweet sorghums are by far the predominant crop grown for silage in Mississippi, and Honey is the most popular variety of this crop.

Changes Brought About In Silage

The silaging process is quite like that of the heating in hay, sweating in grain, and similar changes. When the green, chopped material is first placed in the silo the temperature rises rather quickly to 80 to 90 degrees F. This rise of temperature is proportional to the amount of air present. Coarse chopping and inadequate packing favor high temperatures, and excessive temperatures of the silage mean too much air. The continuation of high temperature after a week indicates that air is entering from the top or sides of the silo. The high temperature is evidence of a high rate of oxidation, and if continued, increases the rate of loss in feed value of the silage.

In a test to determine the effect of fertilization upon the yield and chemical composition of sorghum silage, the Agronomy and Chemistry Departments of the Mississippi Agricultural Experiment Station have collected data which show some of the principal changes taking place in the making of silage. Honey sorghum was harvested in the hard dough stage, cut with a hand-operated silage cutter into pieces one-fourth to one-half inch in length, and placed into quart fruit jars and packed with hammer handles. This material and juice from this material was analyzed periodically thereafter for 30 days to determine some of the chemical changes taking place.

The analyses of the total sugars for different dates after cutting are shown in table 1. The results of both are reported as milligrams in 100 cubic centimeters of juice.

These data show that during the first few days after packing in jars the total sugar decreases in amount very rapidly and a minimum is reached in 15 to 21 days. From this stage on, the presence of air will not allow the proper preservation of the silage, because in jars that were not properly packed the air permitted the development of molds.

A large part of the loss in the total sugars can be accredited to the formation of acids, chiefly lactic acid which is the acid found in sour milk. The analyses of the lactic acid for different dates after cutting are given in table 2 as milligrams in 100 cubic centimeters of juice.

These data show the rapid development of lactic acid within 3 days after the sorghum was placed in the jars until a maximum was reached within 15 to 21 days. These two tables show clearly that as the amount of total sugars decreases the amount of lactic acid increases. The development of this acid results in the preservation of the silage, for in the presence of this acid fermentation is impossible and the bacteria which causes decay cannot live. If air should enter, then molds would develop, the acidity would be counteracted, and bacteria which cause putrefaction would thrive. This explains why there is decayed silage on top of the silo. The development of lactic and acetic acid causes the silage to change color, develop an aromatic odor, and gives it a sour taste. The degree of acidity is a good check on preservation; good silage has a pH of 4.0 or thereabouts.

Stage of Cutting Sorghum

In spite of its high tonnage yield per acre, one of the greatest and costliest disadvantages associated with the growing of

Table 1. Effect of fertilizer on yield and chemical composition of sorghum silage, recorded at intervals after cutting.

Fertilizer treatment	Total sugars as milligrams in 100 cc. of juice					
	Day of cutting	Days after cutting				
		3	9	15	21	30
None	12116	5400	4860	4400	3630	3540
600 lbs. 6-8-4	15517	7275	7950	4270	5570	3300
1200 lbs. 6-8-4	15333	8542	6310	7070	6590	6540
1800 lbs. 6-8-4	14875	8275	8100	4680	6500	4610
2400 lbs. 6-8-4	16090	9342	7330	7210	1880	1560

Table 2. The progressive formation of lactic acid in sorghum silage.

Fertilizer treatment	Lactic acid as milligrams in 100 cc. of juice					
	Day of cutting	Days after cutting				
		3	9	15	21	30
None	171	1270	1756	1747	1891	1891
600 lbs. 6-8-4	135	1243	1441	1189	1891	1486
1200 lbs. 6-8-4	153	1135	1441	1585	1801	1711
1800 lbs. 6-8-4	189	1189	1486	1567	1657	1216
2400 lbs. 6-8-4	144	1264	1576	1585	1549	1756

sorghum for silage is its tendency to lodge as the crop approaches maturity. Especially is this true on the more fertile soils and where relatively high rates of nitrogenous fertilizers have been applied. Lodg- cases it is more economical to utilize a low-growing but lesser-yielding variety ing necessitates the use of considerable amounts of hand labor to harvest the sorghum from the field and get it to the silo for cutting and filling. In many which can be harvested with machinery, than a more vigorous high-yielding variety giving a greater per acre tonnage which must be harvested by hand labor.

Except in the event of heavy rains and winds, the tall-growing sweet sorghums do not begin to lodge badly until after the dough stage of growth has been reached. To determine whether the quality of silage would be greatly affected by stage of growth at time of harvest, and to determine whether sweet sorghum could be harvested before lodging and yet make good silage, the Agronomy and Chemistry Departments harvested and siloed Iceberg sorghum at various stages of growth. The analyses of the silage made from sorghum at the various stages of growth are given in table 3.

From this table it may readily be seen that good silage can be made from sweet sorghum when harvested in the soft-dough stage. More especially is this true when the content of starch and sugar is considered. The carbohydrate content at maturity is only 2 percent more than at soft-dough, whereas there is slightly more undesirable crude fiber at the mature stage. The great difference in starch and sugar content between the mild and soft dough stages would strongly indicate that sorghum should not be cut for silage before the soft-dough stage.

Silage From Crops Other Than Sorghum and Corn

Legumes

Several sections of the State produce considerable amounts of alfalfa and other legumes for hay. In many seasons in Mississippi the weather is very likely to be troublesome during the time of the first cutting for hay, and plans to put part or all of this cutting in the silo may provide a practical and a satisfactory alternative.

It might be well to point out that many experiment stations have found that there is no marked or special superiority of legume silage over the hay in feeding value, provided the hay is harvested at the proper stage of maturity and cured to retain most of its leaves and color. The labor necessary for making silage is greater than that required for making hay. It is questionable that silage should be made of alfalfa or other legumes under conditions favorable for the making of highest quality hay. It is much more difficult to make good silage out of a protein-rcih crop, such as alfalfa, than it is from corn or sorghum.

Table 3. Composition of silage from sorghum at varying stages of growth.

	Stage of growth									
	Boot		Milk		Soft dough		Hard dough		Mature	
	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Moisture	81.64	—	78.78	—	75.48	—	74.87	—	72.91	—
Crude fat	.34	1.86	.42	1.99	.47	1.90	.64	2.52	.49	1.81
Crude fiber	5.30	28.89	5.31	25.02	5.57	22.71	5.89	23.43	6.55	24.15
Ash	1.29	7.03	1.20	5.64	1.19	4.86	1.52	6.02	1.76	6.47
Crude protein	.83	4.50	1.25	5.88	1.01	4.10	1.12	4.45	.82	3.03
N-free extract	10.60	57.73	13.04	61.34	16.30	66.44	15.98	63.60	17.48	64.55
Starch, sugar	—	4.7	—	3.6	—	14.6	—	14.8	—	16.6
pH	3.45	—	3.55	—	3.70	—	3.85	—	—	—
Carotene, gammas per gram	9.75	48.75	15.11	68.88	14.22	59.25	14.30	52.30	—	—

Alfalfa and other legumes should be cut for silage at a slightly less mature stage of growth than they are usually cut for hay: alfalfa when about in 1/10th bloom, and soybeans at the early pod stage.

The high protein and calcium content and low sugar content of legumes favor the development of undesirable types of bacteria, and special precautions must be taken to insure the proper preservation. It is almost necessary to add some type of preservative to a legume to aid in producing more fermentation or to provide acids directly. Molasses, phosphoric acid, or mixtures with sorghum or corn are the most common preservatives used. Molasses is usually preferred because of not being harmful and because the addition of molasses usually improves the palatability of the silage. Partial drying is advantageous in the case of spring clovers; the moisture content of forage crops when being put into the silo should be from 50 to 70 percent moisture.

To determine conditions favorable for the making of good silage out of various forage crops the Agronomy and Chemistry Departments have conducted tests over several years with various crops. Results from these tests are shown in following paragraphs.

Persian Clover

Persian clover is especially adapted to moist and fertile bottomlands where it can be efficiently utilized for grazing or hay. Some planters have experienced years in which they have had an overabundance of this clover and at the same time have had weather which would not permit the making of high quality hay. The Agronomy and Chemistry Departments made trials on this plant material to see if silage could be made of it. These trials may be summarized by giving the conditions necessary for silage making. The material should be wilted so that it contains at least 25 percent dry matter, which at early flowering stage requires from 2 hours to 4 hours wilting in the swath. This material can then be ensiled, provided that at least 18 pounds of 75 percent phosphoric acid or 70 pounds of blackstrap molasses per ton are added. Such material, ensiled with these minimum requirements, gave satisfactory silage, while the untreated material spoiled (table 4).

Vetch

Vetch is widely used as a soil-improving crop and is sometimes utilized as a hay or for temporary grazing. To determine processes necessary to its utilization as a silage crop, hairy vetch containing 85 percent moisture was harvested with a mowing machine, cut to ¼ to ½-inch lengths with a hand cutter, treated in various ways, and compacted and seal-

Table 4. Effect of treatment on Persian clover ensiled at 74 percent moisture.

Silage treatment	pH	Percent protein (dry basis)
None	5.65	spoiled
18 pounds phosphoric acid	3.90	22.12
70 pounds molasses	4.05	20.09

Table 5. Effect of treatment on vetch* ensiled at 85 percent moisture.

Treatment per ton, green weight	pH	Calcium	Phosphorus	Protein
None	5.80	spoiled	spoiled	spoiled
12 lbs. acid	4.80	1.17	.41	23.84
15 lbs. acid	4.65	1.15	.45	24.33
18 lbs. acid	4.55	1.16	.94	23.50
21 lbs. acid	4.50	1.18	.94	23.98
50 lbs. molasses	4.60	1.10	.94	24.37
70 lbs. molasses	4.50	1.19	1.23	24.10
90 lbs. molasses	4.80	.33	.55	24.50

*Dry basis.

Table 6. Effect of treatment on hairy vetch ensiled* at 69 percent moisture.

Treatment per ton, green weight	pH	Calcium	Phosphorus	Protein
None	4.90	1.13	1.81	26.20
12 lbs. acid	4.20	1.27	.94	24.57
15 lbs. acid	4.15	1.25	1.18	24.29
18 lbs. acid	4.20	1.21	1.24	25.81
21 lbs. acid	4.00	1.09	1.89	25.96
50 lbs. molasses	4.10	1.19	1.80	26.35
70 lbs. molasses	4.20	1.24	.53	26.23
90 lbs. molasses	3.80	1.19	1.23	26.38

*Dry basis.

Table 7. Chemical composition of silage made from combinations of soybean and sorghum, treated and untreated.

	¼ Beans & ¾ Sorghum			½ Beans & ½ Sorghum			¾ Beans & ¼ Sorghum		
Silage treatment	Calcium	Phosphorus	Protein	Calcium	Phosphorus	Protein	Calcium	Phosphorus	Protein
	Analyses dry weight basis								
None	.82	.24	7.25	1.34	.31	11.47	1.67	.29	14.22
12 lbs. acid	.81	.94	7.24	1.23	1.11	10.59	1.51	.79	13.74
15 lbs. acid	.85	.98	7.94	1.37	1.25	12.27	1.58	1.09	14.89
18 lbs. acid	.88	.91	7.96	1.27	1.39	10.58	1.28	.98	12.41
21 lbs. acid	.88	1.76	8.34	1.05	1.09	9.93	1.60	1.48	16.13
50 lbs. molasses	.77	.28	7.94	1.13	.29	11.03	1.42	.35	13.26
70 lbs. molasses	.89	.31	9.09	1.19	.31	11.28	1.51	.30	14.73
90 lbs. molasses	.92	.29	8.69	1.58	.38	14.38	1.49	.29	14.40

ed in quart fruit jars. The analyses of the variously treated plant material at different moisture contents are given in table 5.

All the silages in this group were of extremely bad quality with very bad odor. Vetch at this moisture content without treatment failed to make silage. These data clearly show that the moisture content was too high to produce quality silage with the amounts of preservatives used.

This table shows that wilting vetch from its natural moisture content of 85 percent to a 69 percent moisture content enabled the production of silage. This silage was only fair in quality, except those lots receiving 21 pounds of 75 percent phosphoric acid per ton or 90 pounds of blackstrap molasses per ton. It is strongly recommended to those contemplating the making of silage from vetch, that the mowed material be thoroughly wilted before being sent through the ensilage cutter, and that rather large amounts of preservatives be added.

Soybeans

Soybeans were found to be similar to Persian clover and vetch in ensilage requirements, in that the crop should be wilted and some preservative used to insure fermentation. Soybeans as cut, with 76 percent moisture, ensiled with the same treatments as given above for vetch, reacted in the same unsatisfactory manner. Most samples gave pH values higher than 4.8 and possessed a foul odor. Those samples wilted in the field so as to contain less than 69 percent moisture (31 percent dry matter) made silage of a fair to excellent quality. Soybean silage on a dry basis was found to be relatively high in calcium (0.66 to 1.51 percent), phosphorus (0.54 to 1.48 percent), and protein (16 to 26.5 percent).

Because of the high content of calcium, phosphorus, and crude protein in legumes such as soybeans, it was deemed advisable to prepare silages containing varying proportions of soybeans and sorghums, with and without the addition of preservatives. Green material consisting of ¼,

½, and ¾ parts soybeans and sorghum were prepared. The analyses of the silages prepared from these mixtures are contained in table 7, and are on a dry basis.

These data, like those with soybeans, of soybeans is increased, so is the calcium, phosphorus, and crude protein content increased. They also show that as the amount of phosphoric acid added per ton is increased, so is the phosphorus content of the silage increased. Sorghum in the proportion of one-fourth of the weight of material going into the silo furnished enough fermentable sugars to result in the production of good silage. The addition of molasses did not increase the phosphorus content but did slightly raise the calcium content. Analyses of the soybeans (69.42 percent moisture) used in these mixtures show that in all cases the protein content of the soybeans dropped after ensiling. The composition of the soybeans used was 69.42 percent moisture, 1.78 percent calcium, 0.34 percent phosphorus, and 16.40 percent protein. As the percentage of soybeans was increased in the mixture, likewise was the percentage of the constituents analyzed increased regardless of the treatment and kind and amount of preservative used.

Alfalfa

In many years the conditions for curing the first cutting of alfalfa are unfavorable on account of excessive rainfall or moist weather, and considerable amounts are lost that possibly could be saved by putting into the silo. Attempts to ensile freshly cut alfalfa, usually with a moisture content of approximately 75 percent, have given about as many failures as successes even with the use of relatively large amounts of preservatives. This leads to the recommendation that alfalfa be mowed and allowed to wilt 2 to 4 hours in the swath before putting into the silo. In tests to determine the moisture content at which this material may be successfully ensiled, alfalfa containing 75.37 percent moisture was ensiled as cut, and was ensiled at various percentages of moisture with and without preservatives. The results are given in table 8.

These data show that as the proportion show that the addition of phosphoric acid increased the phosphorus content of the silage. The silage made from the alfalfa containing 74.63 percent moisture was of

Table 8. Effect of percentage of moisture and treatment on the quality of alfalfa silage.*

Treatment per ton, green weight	74.73% Moisture			54% Moisture			50.21% Moisture		
	Calcium	Phosphorus	Protein	Calcium	Phosphorus	Protein	Calcium	Phosphorus	Protein
None	2.38	.24	18.97	2.03	.26	17.46	2.08	.23	18.06
12 lbs acid	2.23	1.18	18.61	1.91	.79	17.04	1.93	.48	18.08
15 lbs. acid	2.09	1.36	18.31	1.89	.76	16.78	1.93	.48	17.43
18 lbs. acid	2.05	1.06	18.33	1.91	1.01	16.95	1.99	.83	16.20
21 lbs. acid	----	----	----	----	----	----	----	----	----
50 lbs. molasses	2.14	.25	18.89	2.06	.26	16.16	1.99	.23	17.35
70 lbs. molasses	2.08	.25	18.49	2.19	.22	16.60	1.02	.22	17.67
90 lbs. molasses	2.13	.24	17.70	2.08	.23	17.45	1.08	.21	17.58

*Dry weight basis.

Table 9. Effect of treatment on chemical analyses of crotalaria intermedia silage.*

Treatment	pH	Calcium	Phosphorus	Protein
None	5.70	Spoiled	—	—
6 lbs. acid	4.45	.63	.61	15.99
12 lbs. acid	4.45	.85	1.28	15.28
18 lbs. acid	4.10	1.00	1.79	18.51
24 lbs. acid	4.15	.93	2.05	17.32

*Dry basis.

only a fair quality and had a rather bad odor while that from alfalfa with a lower moisture content made silage which was good quality and with a pleasant odor.

Crotalaria Intermedia

Crotalaria intermedia, the species of crotalaria used for forage, was cut and ensiled with varying amounts of 75 percent phosphoric acid. The plant material cut at the early flowering stage contained 72 percent moisture, and on a dry weight basis contained 0.88 percent calcium, 0.28 percent phosphorus, and 20.94 percent crude protein. The analyses of the silage prepared with the different amounts of acid are contained in table 9.

These data bear out the same results as shown with the other legumes and justify the same conclusions that some preservative is needed for the making of silage. To make good quality silage of crotalaria intermedia, it appears to require 18 or more pounds of acid per ton. Amounts less than this permitted the making of silage, but it was of poor quality. The material to which no preservative was added spoiled and was full of mold. Like the other legumes, the phosphorus content of the crotalaria silage increased as the amount per ton of acid was added.

Sweetpotatoes and Sweetpotato Vines

Although the sweetpotato is grown largely for human food, a portion of each crop fails to meet market requirements and there are times when attractive prices cannot be obtained. A review of feeding experiments, conducted by this and other experiment stations, will show that when used in combination with other feeds sweetpotatoes make a very satisfactory and efficient supplement ration. One-hundred pounds of sweetpotato silage has been found by the Florida Experiment Station (Press Bulletin 274) to be equal to 150 to 200 pounds of corn silage in the ration for dairy cows.

Several Stations have received marked increases in milk flow from dairy cows as a result of grazing sweetpotato vines. Other tests show that the removal of vines before maturity reduces the yield of potatoes, the reduction depending upon the amount removed and the time of removal. Investigations by this Station (Miss. Tech. Bull. 27) have shown that it is difficult to make hay of sweetpotato vines. This is due to the high moisture (80-86 percent) content of the vines. That these vines can be saved and utilized as a succulent feed is shown by the results obtained from tests on crops used for silage and on methods of silage making that have been conducted at this Station.

The Mameyita and Triumph varieties were grown on Trinity clay loam and were fertilized with 600 pounds of a 6-8-4 analysis fertilizer. Vines were harvested by cutting at the surface of the soil, then raking. Samples were saved for the purpose of determining the moisture content and the percentage of stems and leaves. As raked, the vines were run through an ensilage cutter. Cut material of the Hodo variety of sorghum was ensiled with the same treatments for comparison. The cut material of both was then treated with various amounts of 75 percent phosphoric acid and blackstrap molasses. Quart fruit jars were packed with this material and tightly sealed.

These varieties produced relatively large amounts of vines per acre. Mameyita produced 24,055 pounds of green weight per acre and Triumph produced 23,087 pounds, which is a production of 12 and 11½ tons, respectively, of silage material per acre. Well over three-fourths or 83.67 percent of this material produced was plant water. Even with this high moisture content the Mameyita produced 3,981 pounds of dry material per acre, followed by Triumph with 3,821 pounds per acre. Nearly one-third or 29.49 percent of this yield consisted of leaves, while the stems accounted for 70.51 percent of the yield.

Table 10. Chemical analyses of sweetpotato vine silage* after various treatments.

Treatment per ton, green weight	pH	Calcium	Phosphorus	Protein	Sugar	Percent Moisture
None	6.1	Spoiled	—	—	—	87.40
6 lbs. acid	3.75	2.64	.88	9.25	5.29	82.32
9 lbs. acid	3.65	2.56	1.05	8.28	4.28	82.56
12 lbs. acid	3.75	2.70	1.84	10.22	3.27	83.17
15 lbs. acid	4.00	2.65	2.14	9.75	4.47	82.77
18 lbs. acid	3.90	2.68	2.25	9.07	3.12	84.12
50 lbs. molasses	3.95	2.52	.36	8.58	3.03	81.70
70 lbs. molasses	3.90	2.44	.41	6.94	3.12	79.84
90 lbs. molasses	3.80	2.56	.44	6.89	3.05	80.89
Dried stems	—	3.30	.36	6.59	4.34	—
Dried leaves	—	4.16	.34	14.03	Trace	—

*Analyses on dry basis.

Table 11. Chemical analyses of Hodo sorghum silage* after various treatments.

Treatment per ton, green weight	pH	Calcium	Phosphorus	Protein	Sugar	Percent Moisture
None	3.70	.46	.34	5.14	7.25	79.77
9 lbs. acid	3.75	.49	1.02	4.75	10.82	78.75
12 lbs. acid	3.75	.46	.99	6.84	16.53	74.71
15 lbs. acid	3.65	.39	1.43	4.46	24.38	76.25
18 lbs. acid	3.60	.53	1.97	6.71	23.55	80.18
50 lbs. molasses	4.00	.53	.18	4.18	20.15	76.03
70 lbs. molasses	3.90	.86	.27	5.27	15.99	75.30
90 lbs. molasses	3.95	.62	.26	6.62	22.48	79.61

*Analyses on dry basis.

Five months after placing the harvested and variously treated plant material into jars, the jars were opened and the silage analyzed for calcium, phosphorus, crude protein, and sugar. These results are contained in table 10.

It will be noted from this data that it is difficult to ensile sweetpotato vines directly after harvest (with 83.67 percent moisture) without the addition of some preservative. Of the 12 samples placed in jars at a moisture content of 83.67 percent without using some preservative, all spoiled. This spoilage was partial decay and the presence of mold.

Significant is the fact that despite a high moisture content, the addition of relatively small amounts of phosphoric acid or blackstrap molasses results in good silage with a pleasant aroma. When a larger amount of the material (18 tons) was put into temporary silo, using 18 pounds of phosphoric acid per ton, it was eaten readily by dairy cattle, poultry, and hogs.

It will be noted that with increased amounts of phosphoric acid the phosphorus content of both sweetpotato vine and sorghum silage also increases. Increased amounts of molasses affected the phosphorus content of both silages only slightly.

The calcium content of the sweetpotato vine silage was outstandingly higher than that of the sorghum silage. With the exception of one treatment, the calcium content of the sweetpotato vine silage was four times that of sorghum, and in this one exception it was a little more than three times the amount.

The sugar content of the silages shows the widest difference. The sorghum silage with no treatment contained more sugar than the highest of the treated sweetpotato vine silage. These data show that with a crop such as sweetpotato vines, having small amounts of sugar, enough of the desirable acids for preservation cannot be formed without supplement; and lacking the necessary acids, the bacteria causing decay are allowed to work, resulting in a mass of partially decayed plant material. To produce silage with such a crop some preservative must be added. These data also clearly show that where preservatives were added the desirable acids were formed, with the results that much of the plant sugar (carbohydrates) was saved. Even with a sweet sorghum material the addition of preservatives resulted in a saving of two or three times the amount of sugar as compared to sorghum silage in which the preserving acids were formed from the plant sugars.

An outstanding characteristic of sweetpotato vine silage as compared with the hay made from the same plant, is the superior carotene content of the silage. The carotene contents of the sweetpotato vine silages reported above are shown in table 12.

Table 12. Carotene content of sweetpotato vine silage after various treatments.

Treatment per ton green weight	Gammas carotene per gram silage	
	Wet basis	Dry basis
Vines at time of ensiling	45.0	279.7
None	Spoiled	Spoiled
9 lbs. acid	18.0	112.5
12 lbs. acid	30.0	116.7
15 lbs. acid	35.1	250.7
18 lbs. acid	30.0	150.0
50 lbs. molasses	10.0	63.0
70 lbs. molasses	15.0	75.0
90 lbs. molasses	18.0	90.0

These data show that the preservation of carotene increased as the amount of acid added was increased up to 15 pounds per ton, but that increased carotene preservation due to still larger amounts of molasses added was at a declining rate. Attempts to make hay of sweetpotato vines have resulted in the production of a hay largely without leaves, very stemmy, and containing almost no carotene. These data show that relatively large proportions of the carotene in green sweetpotato vines is preserved in the silage.

Notes and Discussion

Two of the fundamentals in the making of silage is the presence of fermentable sugars and the exclusion of air. Crops as sweet sorghum, corn, and grass contain enough of these sugars to produce the desired amounts of preserving acids. Legume crops, on the other hand, are high in calcium and protein and low in fermentable sugars and should have some preservative added.

The data presented have shown that the preserving acids, especially lactic acid, are formed at the expense of sugars, and that this reaction begins almost at the time of ensiling. The reduction in the sugar and starch is the greatest loss of feed constituents.

The composition of the silages made from sorghum harvested at various stages of growth clearly show that almost as good a quality silage can be made from sorghums harvested somewhat earlier than now practiced, which amounts to 2 or 3 weeks. This earlier harvesting, in many cases, would enable harvesting with a binder and eliminate much hand labor. Silage made from sorghums harvested earlier than the soft-dough stage, based on these data, would have much less carbohydrates than that made from sorghum harvested a week later. The younger the plant the more water it contains and results in silage with more acid.

Attempts to ensile legumes with a moisture content higher than 70 percent, even with relatively large amounts of preservatives, have given erratic results. As many failures were experienced as successes, and when silage was made it had a very questionable odor. When legumes were wilted to an extent that the moisture content was lower than 70 percent, preferably 60 percent, good silage was produced by adding preservatives.

The data presented indicate that legume crops should be wilted 2 to 4 hours in the swath and ensiled with at least 18 pounds of at least 50 percent phosphoric acid or 50 to 70 pounds of molasses. It should be kept in mind that in making silage of legume crops it is necessary to handle 3 to 4 times as much weight as when the same is made into hay. Also that there is no advantage in the feeding of legume silage over the same crop as hay, provided top quality hay can be made of the crop.

In putting chopped green material into the silo it should be:

1. Put into a silo that affords good drainage.
2. Chopped rather fine, approximately ½-inch.
3. Packed as tightly as possible, and uniformly.
4. In the case of legumes, allowed to wilt in the swath and use some preservative.
5. Rounded off on top with the heaviest chopped green material available.

Utilization of Johnson Grass As Silage

Johnson grass is abundant in some sections of Mississippi. While this crop is usually cut for hay, weather conditions are sometimes such as to make hay production difficult. Under these conditions Johnson grass might be put up as silage. With this in mind it was decided to carry out some tests on the best manner of ensiling Johnson grass, from both chemical and feeding standpoints. The silage was fed to dairy cows, and records were kept on milk production and the gain or loss in weight of the animals. In both the chemical and feeding tests, Johnson grass silage was compared with sorghum silage.

Johnson grass was ensiled in Sisalkraft silos in the fall of 1941, at two stages of maturity, and fed to dairy cattle during the winter months. Table 13 shows the chemical analysis of the Johnson grass before and after being made into silage and the composition of the sorghum silage. Practically all of the sugar and starch in the Johnson grass silage disappeared after being made into silage. The sorghum silage still contained considerable sugar and starch when fed. About half of the carotene was lost from the Johnson grass during the process of ensiling. The immature Johnson grass silage contained over twice as much carotene as did the mature Johnson grass silage. The mature Johnson grass silage contained about the same quantity of carotene as did the sorghum silage.

Feeding tests indicated that the immature Johnson grass silage was equal to sorghum silage, both in milk production and in maintaining the weight of the dairy cows, but that the mature Johnson grass silage was inferior to sorghum silage. Calcium and phosphorus were higher in the immature Johnson grass silage than in the sorghum silage. The mature Johnson grass silage contained more calcium than the sorghum silage, but the phosphorus was about the same.

The degree to which the blackstrap molasses contributed to the composition was not determined, but the data collected in 1943 (table 15) suggest that the blackstrap molasses did not contribute appreciably to the composition, except in sugar.

In 1942, Johnson grass silage was put up in what might be called a good hay stage, or slightly more advanced than the "immature" silage for 1941. Again the silage was placed in temporary wire Sisalkraft silos of about the same sizes as were used the previous year. The following treatments were studied: (1) Cut with a silage cutter, (2) crushed with a hay crusher in the field, and (3) neither cut nor crushed (mowed only). Blackstrap molasses was added at the rate of 60 pounds per ton of grass.

According to the feeding tests, the silage cut with the silage cutter was equal to sorghum silage, while the crushed Johnson grass silage was inferior to sorghum silage. The uncrushed and uncut silage completely spoiled. The weights per cubic foot of the unsettled silage were: (1) Cut with silage cutter, 26.7 pounds; (2) crushed, 19 pounds; and (3)

Table 13. Chemical composition[1] of Johnston grass[2] and sorghum[3] silage when fresh and when fed, results for 1941-1942.

Type of silage	Preservative	Treatment	Moisture	Crude fat	Crude fiber	Calcium (Ca)	Phosphorus (P)	Protein	Nitrogen free extract	Starch and sugar	Total acidity	Carotene	pH
			Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.		ml N/10 NaOH	p.p.m.	
Immature (fresh) Johnson grass	None	None	67	—	—	—	—	6.00	—	5.00	1	160	5.7
Immature Johnson grass	50 lbs. molasses per ton of grass	Silage cutter	68	2.5	31.4	1.03	0.37	6.62	49.3	Trace	10	71	4.7
Mature (fresh) Johnson grass	None	None	61	—	—	—	—	5.75	—	4.00	1	85	5.8
Mature Johnson grass	50 lbs. molasses per ton of grass	Silage cutter	65	2.6	36.0	0.95	0.22	6.18	47.3	Trace	7	32	4.8
Sorghum	None	Silage cutter	73	2.6	29.8	0.37	0.23	6.56	54.7	8.70	17	35	3.7

[1] Moisture was calculated as percentage of the fresh weight; crude fat, crude fiber, ash, calcium, phosphorus, protein, soluble protein, nitrogen-free extract, and sugar as percentage of the dry matter; total acidity as ml. N/10 NaOH per gm. of dry matter; carotene as of the dry matter.

[2] Immature Johnson grass was cut just as a few panicles were showing and mature Johnson grass when the plants were past their prime and were woody.

[3] Sorghum was cut when the seed was about two-thirds mature.

Table 14. Chemical composition[1] of Johnson grass[2] and sorghum[3] silage when fresh and when fed, results for 1942-1943.

Type of silage	Preservative	Treatment	Moisture	Crude fat	Crude fiber	Calcium (Ca)	Phosphorus (P)	Protein	Nitrogen free extract	Starch and sugar	Total acidity	Carotene	pH
			Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.		ml N/10 NaOH	p.p.m.	
Johnson grass (fresh)	None	None	65	—	—	—	—	6.25	—	5.49	2	164	5.7
Johnson grass	60 lbs. molasses per ton of grass	Silage cutter	68	1.7	33.8	1.14	0.29	7.18	45.6	1.95	9	74	4.8
Johnson grass	60 lbs. molasses per ton of grass	Crusher	72	1.6	35.5	1.19	0.26	7.10	46.1	1.75	9	84	4.9
Sorghum (fresh)	None	None	70	—	—	—	—	5.62	—	19.80	2	46	5.7
Sorghum	None	Silage cutter	70	1.1	27.2	0.59	0.18	6.30	59.7	12.50	8	22	4.1

[1] Moisture was calculated as percentage of the fresh weight; crude fat, crude fiber, ash, calcium, phosphorus, protein, nitrogen-free extract, sugar, and starch as percentage of the dry matter; total acidity as ml N/10 NaOH per gm. dry matter; carotene as p.p.m. of the dry matter.

[2] Johnson grass was cut just as a few panicles were beginning to show.

[3] Sorghum was cut when the seed was about two-thirds mature.

mowed only, 15.1 pounds. Evidently the unsettled weight for good Johnson grass silage should be more than 19 pounds per cubic foot. Table 14 shows the chemical composition of the Johnson grass and sorghum silages for the 1942 season.

The chemical analysis shows that both the sorghum and Johnson grass lost considerable sugar and starch when made into silage. Again carotene, calcium, and phosphorus were higher in the Johnson grass than in the sorghum silage.

In 1943, it was decided to test the preservation of Johnson grass in small trench silos, rather than in Sisalkraft silos as used the previous 2 years. These silos were built on the side of a fairly steep slope. The pits were about 25 feet long and 6 feet deep at the upper ends. The following treatments were used: (1) cut with silage cutter and no blackstrap molasses added, (2) cut with silage cutter with blackstrap molasses added at rate of 60 pounds per ton of grass, and (3) not cut (mowed only) and no molasses added.

The silage cut with the silage cutter, whether blackstrap molasses was added or not, kept about the same and both seemed about equal to sorghum silage in feeding value. The uncut Johnson grass was largely spoiled, although small pockets of fair silage were present. The chemical data for the 1943 study were, in general, similiar to those already presented (table 15).

Many laboratory tests were conducted in order to determine the effect of preservatives on the keeping of Johnson grass silage. These tests indicated no preservative was necessary, although the preservatives did have some influence on the pH (acidity) of the silage (table 16). Neither blackstrap molasses nor phosphoric acid had any marked influence on the carotene content of the silage, although large quantities of blackstrap molasses tended to lower it somewhat. The lowering of the carotene content due to large rates of application of blackstrap molasses can be ascribed to its diluting the carotene that was initially present in the Johnson grass.

UTILIZATION OF SILAGE BY BEEF CATTLE

Silage has been used as the principal roughage for wintering mature cows and growing cattle since the beginning of the beef cattle program at State College more than 40 years ago. Silage has also been extensively used in finishing rations for mature steers and younger cattle.

Experimental results have consistently shown that silage fed ad libitum plus 6 to 8 pounds of cottonseed meal and 3 pounds of grass hay, constitutes one of the most economical rations for finishing mature plain steers, such as are usually fed out in Mississippi. Experimental results indicate also that when beef cattle are wintered primarily on harvested roughages, silage will be rated toward the top of the list, economy considered.

Comparison of Silage Crops

In the earlier years of the State College beef cattle program, silage was produced primarily from corn notwithstanding the fact that experimental work was carried on with other crops like sunflowers, the sorghums, and even cotton stalks. In 1926, the Animal Husbandry Department began a series of experiments with three of the then leading silage crops in order to study comparative yields and feeding values. Sagrain, Goliad corn, and Honey sorghum (commonly called Texas Seeded Ribbon Cane) were planted in the same field, 10 rows being planted in sagrain, 10 in corn, and 10 in sorghum, and this method of planting continued for the entire width of the field. The average annual yields per acre for the three years were: corn 8.07 tons, sorghum 19.6 tons, and sagrain 10.56 tons.

For the 3 years in which these crops were grown, weather conditions were considered to be normal and the yields an average of what one might expect on reasonably good land.

Table 15. Chemical composition[1] of Johnson grass[2] silage when fresh and when fed, results for 1943-1944.

Type of silage	Preservative	Treatment	Moisture	Crude fat	Crude fiber	Calcium (Ca)	Phosphorus (P)	Protein	Nitrogen free extract	Starch and sugar	Total acidity	Carotene	pH
			Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.		ml N/10 NaOH	p.p.m.	
Johnson grass (fresh)	None	None	66	1.6	34.6	0.87	0.18	5.00	51.2	9.20	2	100	5.7
Johnson grass	None	Silage cutter	68	2.4	31.0	1.05	0.26	5.50	50.0	1.87	6	76	4.8
Johnson grass	60 lbs. molasses per ton of grass	Silage cutter	66	2.0	30.0	1.15	0.24	5.50	51.5	3.50	5	70	4.7

[1] Moisture was calculated as percentage of the fresh weight; crude fat, crude fiber, ash, calcium, phosphorus, protein, soluble protein, nitrogen-free extract, sugar, and starch were calculated as percentage of the dry matter; total acidity and volatile as ml N/10 NaOH per gm. of dry matter; carotene as p.p.m. of dry matter.

[2] Johnson grass cut just as a few panicles were beginning to show. High sugar content probably due to growth of the grass under drouth conditions.

Table 16. The effect of different quantities of blackstrap molasses and phosphoric acid on the pH and carotene content of the Johnson grass silage stored in quart jars.

Treatment	Pounds per ton	pH	Carotene p.p.m. dry matter
	0	4.7	103
	30	4.5	—
Blackstrap molasses	60	4.4	96
	120	4.2	90
	240	4.1	84
	0	4.7	103
	2	4.6	—
Phosphoric acid (50%)	8	4.7	100
	16	4.1	101
	32	3.8	106

The feeding value of the silage from the three plants was compared by full feeding the silage, as well as cottonseed hulls, along with cottonseed meal and a small amount of grass hay, to mature common steers for 120 days.

In these experiments the relative feeding value of silage produced from the three crops was determined by comparison with cottonseed hulls. One hundred pounds of cottonseed hulls was equal in feeding value to 189 pounds of corn silage, or 249 pounds of sagrain silage, or 272 pounds of sorghum silage.

The results of these experiments indicated that Honey sorghum, even though slightly lower in feeding value, was far superior to corn and sagrain in terms of total nutrients produced per acre on account of high tonnage. Because of the heavy yielding characteristic and a satisfactory feeding value, Honey sorghum was selected as the principal silage crop, and has been used for the past 20 years on the Mississippi Experiment Station farm as a silage crop for beef cattle.

Honey sorghum, as well as other heavy yielding varieties, lodges or blows down badly, which constitutes a very serious objection due to the large amount of hand labor required and the added cost of harvesting.

Silage for Wintering Beef Cattle

Sorghum silage has been used as the principal roughage in wintering rations for beef cattle since its selection as the leading silage crop. As was true with finishing mature steers, beef heifers and mature cows have been wintered cheaper when the bulk of the ration was sorghum silage than when any other harvested feeds were used. For a number of years the Experiment Station beef herd was wintered on experimental rations including the use of most of the roughages commonly grown in the area.

Included in these experiments were comparative studies of soybean hay, Johnson grass hay, lespedeza hay, cottonseed hulls, and sorghum silage. Out of these studies came the State College standard wintering rations for beef cattle. The rations recommended for the different ages of cattle are as follows:

Mature cows:
  30 pounds sorghum silage
  5 pounds Johnson grass hay
  1 pound cottonseed meal
Yearling heifers:
  25 pounds sorghum silage
  5 pounds Johnson grass hay
  1½ pounds cottonseed meal
Weanling heifers:
  15 pounds sorghum silage
  3 pounds Johnson grass hay
  1½ pounds cottonseed meal

Since the average length of the wintering period for this section is 100 days it is seen that feed requirements for each mature cow are 1½ tons of sorghum silage, ¼ ton of rough hay, and 1 sack of cottonseed meal. This amount of har-

Table 17. Urea-treated silage in the ration of mature beef cows and yearling heifers.

	Lot 1	Lot 2	Lot 3
Mature cows	Standard ration 30 lbs. untreated silage 1 lb. cottonseed meal 5 lbs. Johnson grass hay	35 lbs. untreated silage 5 lbs. Johnson grass hay	35 lbs. urea-treated silage 5 lbs. Johnson grass hay
Number cows per lot	10	10	10
Av. initial weight, lbs.	1017	1104	1111
Av. final weight, lbs.	1026	1005	1124
Av. gain or loss in weight, lbs.	9	—99	13
	Lot 4	Lot 5	Lot 6
Yearling heifers	Standard ration 25 lbs. untreated silage 1 lb. cottonseed meal 5 lbs. Johnson grass hay	*30 lbs. untreated silage 5 lbs. Johnson grass hay	30 lbs. urea-treated silage 5 lbs. Johnson grass hay
Number heifers per lot	10	10	10
Av. initial weight, lbs.	573	579	586
Av. final weight, lbs.	634	564	628
Av. gain or loss in weight, lbs.	61	—15	42

*Heifers refused to eat more than 25 pounds untreated silage per head per day.

vested feed, plus good pasture, has maintained the beef cattle breeding herd at State College over a period of years in thrifty condition, and under this system of management the herd has produced better than an 85 percent calf crop.

Fortifying Sorghum Silage With Urea

During recent years research workers at some of the experiment stations found that certain nitrogenous materials would partially take the place of protein supplements, such as cottonseed meal, soybean meal, and linseed meal in cattle rations. The material that gave most promise was urea, which is a granular material carrying approximately 46 percent nitrogen. For several years urea has been used to fortify grain feeds, but only by mixing with the grain as fed.

Realizing that a protein supplement should be fed with sorghum silage for the best results, Mississippi Station workers conceived the idea of fortifying sorghum silage with urea. Ten pounds of urea per ton were added to the silage as it was blown into the silo. A 50-ton silo was filled with the urea-treated silage, which was compared to untreated silage in rations for wintering beef cattle. Three years' observations on the utilization of urea-treated sorghum silage as compared to untreated sorghum silage indicates that the feeding value is considerably improved.

The results of the 1944-45 wintering test with urea-treated and untreated sorghum silage are shown in table 17, which is shown above.

The need of protein in the ration for mature cows is clearly shown in the first section of the table. Those in lot 2, fed untreated silage and Johnson grass hay, lost 99 pounds during the wintering period. Those supplied additional protein, made slight gains. Lot 3, receiving urea-treated silage, was as good as lot 1, which received untreated silage plus 1 pound of cottonseed meal daily.

Work with yearling heifers, shown in the second section of the table, gave results approximately similar. Those in

Table 18. Comparison of rations for fattening common beef steers.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
	C. S. meal, corn silage, Johnson grass hay	C. S. meal, C. S. hulls, Johnson grass hay	C. S. meal, sorghum silage, Johnson grass hay	C. S. meal, sagrain silage, Johnson grass hay	C. S. meal, Johnson grass hay
Number of steers per lot	8	8	8	8	8
Average initial wt. (lbs.)	728.7	727.7	727.6	726.8	728.3
Average final wt. (lbs.)	962.7	965.6	952.0	936.2	931.4
Average daily gain (lbs.)	1.95	1.98	1.87	1.74	1.69
Initial cost per cwt. (dollars)	5.75	5.75	5.75	5.75	5.75
Average daily feed per steer:					
Cottonseed meal (lbs.)	6.55	6.55	6.55	6.55	6.55
Silage (lbs.)	43.35	—	50.96	42.53	—
Cottonseed hulls (lbs.)	—	21.88	—	—	—
Johnson grass hay (lbs.))	3.00	3.00	3.00	3.00	21.11
Feed required per cwt. gain:					
Cottonseed meal (lbs.)	335.88	830.84	350.29	376.43	387.56
Silage (lbs.)	2222.19	—	2725.34	2444.20	—
Cottonseed hulls (lbs.)	—	1105.16	—	—	—
Johnson grass hay (lbs.)	153.84	151.53	160.44	172.41	1249.09
Shrink (percent)	7.35	8.70	8.04	8.60	6.21
Dressing (percent) (warm wt.)	56.20	55.51	53.89	54.24	53.97

lot 5, receiving no protein supplement, lost in weight an average of 15 pounds. Those fed urea-treated silage plus hay gained an average of 42 pounds in weight, while those fed 1 pound of cottonseed meal daily, in addition to the untreated silage and hay, gained in weight an average of 61 pounds.

Silage for Finishing Steers For Market

In general it can be said that Mississippi is not a beef cattle finishing State. This is particularily true where large amounts of grain are involved in fattening rations. It is believed, however, that there is an opportunity for more cattle to be finished to medium and good grades on home grown roughages plus cottonseed meal or cottonseed cake and a small amount of hay.

Naturally, the grades of cattle that will handle this type of ration most economically are common, medium, and good 2-year-old or older steers. Two-year-old or older steers will consume about 50 pounds of silage per day for 120 days, along with 6 to 8 pounds of cottonseed meal and 3 pounds of hay. The daily gains for thrifty cattle should range from 1.75 to near 2 pounds.

This type of cattle finishing program represents the sale of a high-yielding crop plus a home-grown concentrate and a minimum of hay through the grades of cattle that usually are available in the State. Such a practice over a period of years will no doubt result in improved soils by properly handling the manure produced from the feeding operations.

A demonstration of the performance of mature common steers when full fed sorghum silage and corn silage, both lots receiving a basic ration of cottonseed meal and Johnson grass, is shown in table 18.

Reference to the table will indicate that the several roughages used in the comparison did not vary greatly in feeding efficiency when costs and returns are considered. Average daily gains by lots were as follows: corn silage 1.95 pounds, cottonseed hulls 1.98 pounds, sorghum silage 1.87 pounds, sagrain silage 1.74 pounds, Johnson grass hay 1.69 pounds.

Of the three silage lots, steers receiving corn silage consumed 43.35 pounds per day, those receiving sorghum silage consumed 50.96 pounds per day, while those receiving sagrain silage consumed 42.53 pounds per day. There was little difference in the selling price per hundred weight between the 5 lots.

This feeding test seems to confirm that corn silage is slightly superior to sorghum silage on a pound-for-pound basis; but is confirmation also, that sorghum silage is a very satisfactory succulent roughage. The fact that sorghum yielded 19.6 tons while corn yielded only 8.07 tons of silage per acre appears to be a logical explanation of the fact that sorghum has almost completely replaced corn as the principal source of silage since these results were published.

UTILIZATION OF SILAGE BY DAIRY ANIMALS

In the corn belt, corn silage is recognized as the best and most economical succulent feed that can be grown for winter feeding. While the value of this crop in Mississippi is recognized, corn yields are often low and uncertain on most farms if planted late. Sorghum, especially the larger growing varieties, will be found more economical than corn because of the much larger yields per acre. The yield of sorghum is often 50 to 100 percent more than corn, and experiments indicate that 15 to 20 tons of sorghum to the acre is not an unusual yield. On the same land, 8 to 12 tons of corn would be considered a fair crop.

Silage as a feed for dairy cows has many advantages, among which may be named: it is palatable, digestible, succulent, bulky, healthful, easily kept, and it is cheap. One of the chief advantages over hay is the fact that silage can be harvested under weather conditions that would make the saving of No. 1 hay difficult or impossible.

Many crops such as corn, sagrain, alfalfa, soybeans, and most of the grasses and legumes may be used for silage, but for most farms in Mississippi sorghum is recommended. Some of the reasons for this are:

1. Compared with other crops, the yield of sorghum silage is large.

2. When planted thick in 3½-foot rows (1/4 to 1/3 bushel seed per acre) and cultivated early, no hoeing is required.

3. Sorghum may be planted any time between April 1 and June 15, thus making it possible to plant after winter cover crops have been removed.

4. It may be cut for silage from the soft-dough stage until the seed are thoroughly ripe but may stand for two or three weeks after this without material injury, while corn should be cut just after it passes the roasting ear stage and rapidly depreciated in quality after this point has been reached.

5. Due to the large yield and the low cost of production, sorghum is one of the most economical feeds that may be grown for silage.

6. Ton for ton, sorghum silage is not worth as much as corn silage. One ton of the latter has a feeding value equal to 1.11 tons of sorghum, but the yield of sorghum is often 1½ to 2 times that of corn.

During the 10 years in which silage was grown in an experiment by the Dairy Department, a total of 5.95 acres was planted each year in sorghum for silage. The total yield was 208,400 pounds, or an average of 17.6 tons per acre per year.

The total cost of man, horse and tractor labor required for making this silage was $118.47, or $1.13 per ton. This cost was distributed as follows: man labor $54.95 or $0.525 per ton; horse labor $23.20 or $0.222 per ton; tractor labor $40.32 or $0.385 per ton. Labor for growing and harvesting this crop was distributed as follows: preparation and planting $29.97, or $0.286 per ton; for cultivation $9.75, or $0.093 per ton; and for harvesting and putting in silo $78.75, or $0.752 per ton. Total cost per ton $1.13. It required 90 pounds of home-grown seed to plant this area, valued at $1.80. The total cost of labor and seed was $120.27.

The silage was charged to the cows at $3.50 per ton, or a total of $366.45. At this estimated value, value of the silage over cost of labor and seed was $246.18, or $41.37 per acre per year.

Johnson Grass Silage For Dairy Cows

Johnson grass was cut when immature, at the stage when it was just beginning to head out, and was put into small aboveground silos. Into one silo the grass was run through the silage cutter and into another the grass was crushed after mowing but not run through the silage cutter. To each lot was added 60 pounds of blackstrap molasses per ton of silage. The Johnson grass silage did not keep as well as sorghum silage, and that from crushed Johnson grass was less palatable than either sorghum or cut Johnson grass silage. The results of the two winters' feeding indicate that there is very little difference in the feeding values per ton of sorghum silage and cut Johnson grass silage. The results of the first winter's feeding indicate that mature Johnson grass is less valuable than immature, and in the second winter's feeding better results were obtained from cut Johnson grass than from the crushed. The cut grass kept better and was more palatable.

Grass Silage For Young Bulls

When young bulls were fed cottonseed meal alone or in a mixture of cottonseed meal, corn and oats at the rate of 3 pounds per day in addition to hay or pasture, the feed was not sufficient to secure normal growth. The inadequacy of this ration was particularly evident during the winter feeding period, when the bulls were on dry feed and when the hay was of poor quality. Both the rate of development and sperm production varied greatly with the individual animals, irrespective of the concentrates fed. The substitution of grass silage for a portion of the hay resulted in a marked improvement in the animals on all the rations fed. The grass silage contained several times as much carotene as did the hay.

Amount of Silage Needed

The amount of silage most advantageously included in the dairy ration will depend upon several factors. The farmer with plenty of No. 1 hay economically produced can afford to provide less silage per animal than where there is a scarcity of such hay. It must be recognized however that much of the hay saved at present in Mississippi is inferior in quality and of little value as feed for the dairy cow. The amount of silage needed will also depend upon the kind of pasture provided, whether the pasture will furnish good grazing through the summer and fall months. The average dairy cow will need from one-half to two-thirds of a ton of silage per month for as many months as it is found necessary to feed silage. It is better to have too much than too little, for if it is not needed it can be kept until the following year. The Dairy Department of Mississippi State College has fed silage that was kept for 5 years and it appeared to be as good as fresh silage. On this basis, to provide silage for 20 cows for a period of 5 months would require 55 to 75 tons annually.

Calves from 3 months old up may be fed limited amounts of silage with good results, along with hay and concentrates to meet the needed food nutrients required for growth and development.

Dairy heifers respond well to silage, hay, concentrates, salt and water during the winter months or seasons of short pastures.

A small amount of good quality silage adds materially to the diet of breeding bulls, preferably 15 to 20 pounds fed daily along with good quality hay and some concentrates.

Feeding Silage

Legume and grass silage may be fed in place of sorghum or corn silage or in place of part of the hay. Cows will consume more dry matter if fed some hay along with silage than if fed either alone.

In Mississippi it is desirable to feed most of the silage and hay at night, as the cows may often do some grazing during the day throughout most of the year if weather is favorable and provisions have been made for such crops. It is best to feed the silage after milking has been completed and the milk has been removed from the barn, as this will prevent odors from being absorbed into the milk.

Cows that are fed silage stay in better physical condition as shown by brighter eyes, sleeker coats of hair, and keener appetites than those in the same herd not getting silage. Some silage may be fed the bull, heifers, and to calves after about 2 to 3 months old without any detrimental results and it may add materially to their ration especially when No. 2 or No. 3 hay is being fed. In feeding this low quality hay it is hard to get cows to consume enough to supply the needed total digestible nutrients (TDN) in the ration, as such hay is not palatable, and the cows invariably refuse from 10 to 50 percent of poor quality hay even though they are being fed in limited quantities.

During the past winter 12 cows in the College herd, over a period of 156 days, refused 25.96 percent of the Johnson grass hay and 0.32 percent of the sorghum silage. Such refusal in the hay undoubtedly was reflected in the condition of the cow and in the milk yield being decreased, unless additional TDN was supplied by more expensive concentrate feed. The cows were being fed 8 pounds of Johnson grass hay and 30 pounds of sorghum silage per head daily, along with sufficient concentrates to meet the needs of the individual cow.

In another experiment 10 cows that were fed 8 pounds of lespedeza hay and 30 pounds of sorghum silage, refused 11.41 percent of the hay and 1.87 percent of the silage during the test period.

Cows will consume more total digestible nutrients from roughage if a greater proportion of it is supplied in the form of silage than in the usual poor quality hay available for feeding the dairy herd.

The Sweetpotato As a Feed For Dairy Cows

Although the sweetpotato is grown largely for human food, a portion of each crop fails to meet the market requirements and there are times when attractive prices cannot be obtained. To determine the value of this crop as a succulent roughage for dairy cows, the Dairy Department of the Experiment Station compared its feeding value with sorghum silage.

Two groups of five cows each were used. The test lasted 84 days. Both groups received the same amount of a grain mixture consisting of 100 pounds of cottonseed meal, 100 pounds of wheat bran, 200 pounds of crushed ear corn, 4 pounds each of oystershell flour and common salt. In addition each cow received 10 pounds of Johnson grass hay daily.

The cows in group 1 received 30

Table 19. Comparison of chopped sweetpotatoes with sorghum silage for dairy cows.

Group	Gain or loss in live weight	Production			Total feed consumed			
		Milk, lbs.	Fat, pct.	Fat, lbs.	Concentrates	Johnson grass hay	Sorghum silage	Sweetpotatoes
Sorghum silage	121	6588	4.46	293.71	3192	4200	12600	—
Sweetpotato	395	6523	4.49	293.14	3192	4200	—	6930
Difference	–274	65	—	0.57	—	—	—	—

pounds of sorghum silage daily and those in group 2 were given 16½ pounds of chopped sweetpotatoes. Table 19 gives the results.

In this trial the silage and sweetpotatoes fed were of equal value in the production of milk and butterfat. The cows fed silage gained only 0.20 pound per cow per day, while those fed sweetpotatoes gained 0.94 pound.

The results indicate that for milk production 1 ton of sweetpotatoes is equal to 3636 pounds of sorghum silage. From these figures it is concluded that 300 bushels of potatoes would produce as much milk and butterfat as 16.36 tons of sorghum silage.

SILAGE UTILIZATION BY OTHER LIVESTOCK

Sheep. Silage has proved to be a satisfactory winter roughage for sheep when succulent grazing crops are not available. Since sheep consume a relatively small amout of silage it is usually not used in a sheep production program except where dairy or beef cattle are also maintained. The leading succulent winter feed for sheep is that produced from green growing crops such as oats, rye, wheat, and barley with wild winter peas or crimson clover interplanted. Silage ranks next to these crops and above the better quality hays in stimulating milk production after ewes yean.

A satisfactory wintering ration for suckling ewes that do not have access to green feed is: 3 to 5 pounds sorghum silage, 1 pound good quality legume hay, ½ to 1 pound concentrates.

It is believed by good sheepmen that while planning a sheep program emphasis should be placed on more and better grazing crops rather than build a program around silage as the principal succulent feed.

Work stock There are instances where silage has been successfully used as part of the roughage for work stock. A good quality corn or sorghum silage, free from molds and rotten material, might be fed to work stock with safety and would frequently cheapen the carrying cost of idle work stock. However, due to the fact that horses, mules, and jack stock are extremely susceptible to attacks by fungi that cause forage poisoning which is sometimes present in moldy silage, silage cannot be recommended as a work stock feed.

BULLETIN 426 DECEMBER 1945

Cotton Varieties
in the
Hill Section of Mississippi
1945

By

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STATE COLLEGE MISSISSIPPI

COTTON VARIETIES IN THE HILL SECTION OF MISSISSIPPI

By J. F. O'KELLY

The field plot data for these tests were collected by S. P. Crockett, H. A. York, and T. E. Ashley at their respective stations.

The 1945 weather conditions were largely unfavorable for cotton production. A cold, wet planting period caused delayed planting, poor germination, and in some cases tests had to be planted over. Only at Holly Springs did yields approach satisfactory levels.

Because of the unfavorable weather results from the tests were more variable than usual. This again emphasizes the wisdom of studying the averages when trying to evaluate a variety. The current year's results have much of interest but never should be accepted as final.

The lint prices used for the three grades and for the several staple lengths, are averages for 10 weeks of the marketing season. Seed was valued at $52.00 a ton regardless of length of staple or assumed grade. Because of this the total acre values for strict low middling and low middling grades are somewhat greater

Table 1. Cotton variety averages: Poplarville, 1941-1945.

Variety	Annual lint yields					Averages				
	1941	1942	1943	1944	1945	Pounds lint	Total value (2)	Staple length	Lint per-centage	Bolls per lb. lint
Hi-Bred	511.6	278.0	345.3	610.5	446.9	438.5	97.77	27/32	42.5	176
Cleveland 54	487.9	290.0	363.8	513.5	282.3	387.5	91.56	29/32	37.2	219
Stoneville 5A	444.1	385.5	258.7	486.4	334.7	381.9	93.55	1	37.1	227
Miller	437.6	341.2	229.1	540.0	359.9	381.6	93.83	15/16	38.3	192
Deltapine 14	431.5	259.7	252.0	540.5	414.4	379.6	92.89	1 1/32	41.2	212
Bobshaw 1	457.5	349.7	280.8	418.1	316.7	364.6	89.14	1	36.8	226
Coker 100-9 (1)	486.8	274.6	204.1	455.6	398.6	363.9	93.46	1 3/32	38.0	210
Stoneville 2B	469.2	270.3	261.3	439.7	337.8	355.7	89.84	1 1/16	36.1	203
Delfos 9431 (1)	369.1	154.7	268.7	433.8	295.0	304.3	83.08	1 3/32	35.2	243
Delfos 531C	382.8	178.5	165.1	482.3	305.3	302.8	84.22	1 1/8	35.4	259
Boboak	372.0	175.0	253.7	448.3	217.9	293.4	75.99	1 1/16	33.7	263

(1) Data for a closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

Table 2. Cotton varieties: Poplarville, 1945.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint per-centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	446.9	116.12	112.77	102.71	29/32	39.5	176
Empire	432.0	122.33	117.14	103.97	1 1/32	35.3	187
Deltapine 14	414.4	117.09	111.29	97.82	1 1/16	38.2	201
Coker 100-9	398.6	113.97	108.39	95.44	1 1/16	36.4	204
Miller	359.9	100.18	96.22	85.78	31/32	35.2	208
Stoneville 2B	337.8	96.68	92.63	82.33	1 1/32	33.9	207
Stoneville 5A	334.7	95.49	91.84	81.27	1 1/32	34.3	232
Coker 100W-4	331.1	94.46	90.49	80.39	1 1/32	34.3	221
Bobshaw 1	316.7	90.63	86.83	77.17	1 1/32	33.9	215
Delfos 531C	305.3	92.20	87.17	77.24	1 3/32	32.5	243
Delfos 9431	295.0	89.24	84.37	74.78	1 3/32	32.3	233
Cleveland 54	282.3	78.76	75.65	68.03	15/16	34.0	229
Bobdel	274.9	79.45	76.15	67.77	1 1/32	32.7	248
Delfos 050	270.2	77.39	74.15	95.91	1 1/32	33.8	221
Delfos 9169	233.6	67.92	64.65	57.06	1 1/16	34.1	204
Boboak	217.9	63.20	60.58	53.93	1 1/32	32.3	257

Table 3. Cotton variety averages: Holly Springs, hill soil, 1941-1945.

Variety	Annual lint yields					Averages				
	1941	1942	1943	1944	1945	Pounds lint	Total value (2)	Staple length	Lint per-centage	Bolls per lb. lint
Hi-Bred	568.2	735.2	368.6	413.3	719.0	560.9	122.38	27/32	43.2	162
Deltapine 14	647.6	669.6	348.6	408.6	716.5	558.2	134.88	1 1/32	40.5	193
Miller	580.2	652.9	373.2	364.5	680.1	530.2	127.42	31/32	38.5	172
Stoneville 2B	548.3	737.5	320.1	437.1	541.4	516.9	130.67	1 1/16	36.2	195
Bobshaw 1	569.7	789.7	327.8	362.2	534.1	516.7	126.11	1 1/32	37.0	207
Cleveland 54	564.2	621.6	313.0	361.6	638.8	499.8	118.23	15/16	37.8	200
Stoneville 5A	549.3	635.5	341.6	347.1	578.6	490.4	122.15	1 1/32	37.1	213
Coker 100-9 (1)	495.4	621.2	311.7	347.4	557.3	466.6	121.03	1 3/32	38.4	203
Delfos 9431 (1)	526.3	665.1	298.4	345.8	480.6	463.2	121.83	1 3/32	35.7	225
Boboak	530.6	598.5	251.0	332.1	569.6	456.4	121.04	1 3/32	34.0	226
Delfos 531C	525.2	615.0	293.5	333.7	479.8	449.4	123.01	1 1/8	35.1	229

(1) Data for a closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

Table 4. Cotton varieties:: Holly Springs, hill soil, 1945.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint per-centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	719.0	177.62	176.18	161.80	7/8	42.6	132
Deltapine 14	716.5	195.99	187.39	165.53	1 1/32	40.6	159
Empire	681.3	189.47	181.29	160.51	1 1/32	37.9	144
Miller	680.1	185.37	177.89	158.17	31/32	38.2	149
Cleveland 54	638.8	172.39	165.36	148.11	15/16	38.6	166
Delfos 050	628.9	180.58	171.78	151.34	1 1/16	35.8	166
Coker 100W-4	603.5	173.90	165.45	145.84	1 1/16	35.3	177
Stoneville 5A	578.6	166.72	158.62	139.82	1 1/16	35.3	192
Bobdel	574.7	163.83	156.94	139.41	1 1/32	34.4	189
Boboak	569.6	170.01	160.61	142.10	1 3/32	34.0	193
Coker 100-9	557.3	163.97	154.77	136.66	1 3/32	36.0	174
Stoneville 2B	541.4	159.63	150.69	133.10	1 3/32	35.7	166
Bobshaw 1	534.1	153.46	145.98	128.63	1 1/16	35.7	175
Delfos 9169	533.8	152.63	145.16	127.81	1 1/16	36.4	165
Delfos 9431	480.6	139.94	133.22	117.60	1 1/16	33.9	199
Delfos 531C	479.8	144.31	136.39	120.80	1 3/32	33.0	190

Table 5. Cotton variety averages: Holly Springs, valley soil, 1942-1945.

Variety	Annual lint yields				Averages				
	1942	1943	1944	1945	Pounds lint	Total value (2)	Staple length	Lint per-centage	Bolls per lb. lint
Miller	733.5	598.4	622.0	729.3	668.5	172.41	1	36.3	176
Cleveland 54	684.6	579.8	626.2	764.1	663.7	169.82	31/32	36.0	196
Hi-Bred	705.9	635.5	565.5	738.5	661.3	154.66	7/8	40.9	155
Deltapine 14	646.6	652.5	588.3	715.0	650.6	173.29	1 1/16	38.8	206
Stoneville 5A	629.0	589.7	641.0	711.5	642.8	174.21	1 1/16	35.6	209
Stoneville 2B	604.9	641.2	537.6	693.2	619.2	173.45	1 3/32	35.4	180
Bobshaw 1	705.9	561.0	511.1	679.1	614.3	162.93	1 1/16	35.6	202
Coker 100-9 (1)	579.6	570.4	551.6	667.8	592.3	175.03	1 1/8	36.6	193
Delfos 9431 (1)	566.9	527.9	539.5	621.4	563.9	178.81	1 5/32	33.6	227
Delfos 531C	537.6	536.9	558.2	592.5	556.3	180.41	1 5/32	33.7	235
Boboak	522.7	473.8	497.8	608.3	525.7	158.29	1 1/8	32.4	229

(1) Data for a closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

than would be the case if the quality of seed comparable to such lint grades were known.

Seed for these tests was obtained from the originator in all cases.

The tests at Holly Springs were liberally fertilized ahead of planting. The planting was done early in May. Weather conditions later made possible the production of a satisfactory yield.

At State College prolonged low temperatures ruined the first planting in the latter part of April. The second planting was made early in May. Rains in June and July were not excessive and August was the driest on record. Yields were fair.

The Raymond and Poplarville tests were planted on time. Excessive rainfall and insect damage prevented satisfactory yields.

Farmers would do well to examine seed supplies available for planting in 1946 with more than the usual care. In some areas rains during the harvesting season damaged much of the seed. Any supplies which are at all questionable should be tested for germination. In some cases the seed may be entirely unsafe for planting and should be discarded. Other sup-

Table 6. Cotton varieties: Holly Springs, valley soil, 1945.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint percentage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Cleveland 54	764.1	213.75	204.97	182.81	1	35.5	169
Coker 100W-4	754.9	218.48	207.91	183.38	1 1/16	34.7	177
Hi-Bred	738.5	186.09	184.61	169.84	7/8	39.4	137
Miller	729.3	206.05	197.30	175.05	1 1/32	35.6	158
Delfos 9169	723.4	214.64	202.71	179.20	1 3/32	34.8	170
Deltapine 14	715.0	207.14	195.34	172.10	1 3/32	38.4	188
Stoneville 5A	711.5	212.36	200.62	177.50	1 3/32	34.0	182
Empire	696.5	201.29	191.54	168.90	1 1/16	34.9	142
Stoneville 2B	693.2	205.82	194.39	171.86	1 3/32	34.7	164
Bobshaw 1	679.1	196.55	187.05	164.98	1 1/16	34.7	185
Delfos 050	668.5	202.73	191.70	169.97	1 3/32	32.0	182
Coker 100-9	667.8	196.61	185.60	163.89	1 3/32	35.9	169
Delfos 9431	621.4	201.80	185.02	160.17	1 1/8	32.6	200
Boboak	608.3	184.46	174.42	154.65	1 3/32	32.0	212
Delfos 531C	592.5	191.70	175.70	152.00	1 1/8	33.1	209
Bobdel	591.0	179.53	169.78	150.57	1 3/32	31.8	223

Table 7. Cotton variety averages: State College, 1941-1945.

Variety	Annual lint yields					Averages				
	1941	1942	1943	1944	1945	Pounds lint	Total value (2)	Staple length	Lint percentage	Bolls per lb. lint
Deltapine 14	220.7	621.0	585.9	607.4	429.3	492.9	124.50	1 1/16	40.4	192
Cleveland 54	221.9	599.8	494.2	571.4	531.4	483.7	117.22	15/16	37.4	197
Miller	210.5	584.4	541.5	548.2	484.8	473.9	117.57	31/32	37.2	178
Hi-Bred	251.3	574.6	612.3	436.3	482.7	471.4	104.28	27/32	43.0	153
Stoneville 5A	222.0	530.8	540.9	525.5	465.6	457.0	117.27	1 1/32	36.4	210
Stoneville 2B	205.1	571.7	511.1	509.6	473.8	454.3	121.24	1 1/16	35.3	191
Coker 100-9 (1)	269.8	551.2	423.0	562.4	407.8	442.8	119.94	1 3/32	37.8	197
Bobshaw 1	224.1	527.3	480.4	488.7	453.1	434.7	110.96	1 1/32	36.5	208
Delfos 9431 (1)	165.9	520.5	481.6	467.0	380.5	402.7	116.01	1 1/8	34.3	227
Delfos 531C	173.7	515.3	486.5	465.7	363.0	400.8	118.06	1 1/8	34.0	231
Boboak	198.9	459.0	435.6	449.4	393.6	387.3	108.90	1 3/32	33.3	231

(1) Data for a closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

Table 8. Cotton varieties: State College, 1945.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint per-centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Cleveland 54	531.4	140.53	136.54	124.59	29/32	36.9	180
Empire	512.6	144.83	138.68	123.04	1 1/32	35.6	157
Miller	484.8	133.29	127.95	114.86	15/16	35.9	165
Hi-Bred	482.7	117.98	117.02	107.36	27/32	44.5	142
Stoneville 2B	473.8	134.45	128.76	114.31	1 1/32	35.0	174
Delfos 9169	469.2	133.66	128.03	113.72	1 1/32	34.5	178
Stoneville 5A	465.6	132.74	127.15	112.95	1 1/32	34.4	195
Bobshaw 1	453.1	129.37	123.93	110.11	1 1/32	34.2	184
Deltapine 14	429.3	118.56	113.41	100.31	1 1/32	39.0	182
Bobdel	427.7	124.46	119.33	106.29	1 1/32	31.9	209
Coker 100W-4	410.0	116.26	111.34	98.84	1 1/32	35.1	183
Coker 100-9	407.8	117.18	111.47	98.21	1 1/16	35.7	194
Boboak	393.6	117.12	111.61	98.82	1 1/16	31.3	215
Delfos 9431	380.5	115.00	108.73	96.36	1 3/32	32.4	217
Delfos 531C	363.0	106.82	101.74	89.94	1 1/16	32.6	217
Delfos 050	353.7	102.23	97.98	87.19	1 1/32	32.7	197

Table 9. Cotton variety averages: Raymond, hill soil, 1941-1945.

Variety	Annual lint yields					Averages				
	1941	1942	1943	1944	1945	Pounds lint	Total value (2)	Staple length	Lint per-centage	Bolls per lb. lint
Hi-Bred	479.1	710.4	633.8	630.2	482.5	587.2	126.03	27/32	42.3	168
Bobshaw 1	570.8	718.0	607.1	553.9	407.7	571.5	139.58	1	37.0	223
Deltapine 14	494.0	761.9	567.9	600.7	424.1	569.7	137.53	1 1/32	40.6	216
Stoneville 2B	541.8	758.0	550.7	549.0	398.1	559.5	141.34	1 1/16	36.4	201
Coker 100-9 (1)	487.7	768.8	563.4	541.5	423.1	556.9	146.30	1 3/32	38.6	208
Cleveland 54	511.1	713.2	590.4	555.7	370.8	548.2	128.08	29/32	37.2	214
Miller	522.5	693.7	550.6	548.1	405.3	544.0	129.94	31/32	37.7	188
Stoneville 5A	470.4	676.8	543.8	543.9	433.8	533.7	130.86	1	37.4	226
Delfos 9431 (1)	416.2	683.3	498.4	491.2	448.3	507.5	138.60	1 3/32	35.2	241
Delfos 531C	454.6	702.6	483.0	488.9	368.3	499.5	130.61	1 1/8	35.5	241
Boboak	470.2	644.2	484.8	451.0	342.9	478.6	129.13	1 1/16	33.8	243

(1) Data for a closely related strain were used for years before current strain was tested.
(2) Based on middling grade.

Table 10. Cotton varieties: Raymond, hill soil, 1945.

Variety	Pounds lint per acre	Total acre value			Length inches	Lint per-centage	Bolls per lb. lint
		Middling	Strict low middling	Low middling			
Hi-Bred	482.5	119.26	118.29	108.64	27/32	42.5	156
Coker 100W-4	469.6	126.33	125.40	111.07	1 1/32	37.4	200
Delfos 9431	448.3	128.90	122.62	108.05	1 1/16	35.6	237
Stoneville 5A	433.8	121.04	115.83	102.60	1 1/32	37.4	215
Deltapine 14	424.1	116.02	110.93	97.99	1 1/32	40.6	202
Coker 100-9	423.1	118.96	113.03	99.28	1 1/16	39.0	194
Empire	413.6	117.24	111.45	98.01	1 1/16	37.7	170
Bobshaw 1	407.7	114.29	109.40	96.97	1 1/32	36.7	219
Miller	405.3	110.54	106.08	94.33	31/32	38.1	179
Delfos 9169	403.5	112.96	108.12	95.82	1 1/32	36.9	198
Stoneville 2B	398.1	111.60	106.83	94.68	1 1/32	36.7	196
Delfos 050	387.8	110.22	105.56	93.74	1 1/32	34.8	211
Cleveland 54	370.8	100.66	96.58	86.57	15/16	37.7	208
Delfos 531C	368.3	108.43	102.35	90.38	1 3/32	35.9	230
Boboak	342.9	99.85	95.05	83.90	1 1/16	33.9	247
Bobdel	334.8	95.44	91.43	81.22	1 1/32	34.4	229

plies may be usable if the planting rate is increased considerably.

The grower will be fortunate, indeed, if he has a surplus of excellent seed. Any such surplus will very probably be needed somewhere in the State. In fact, if as much planting over should be necessary in 1946, as was the case in 1945, a shortage of good seed could cripple production seriously. Do not use guesswork about planting seed.

Table 11. **Yields at the several Mississippi locations, 1945.**

	Pounds lint per acre					
	Holly Springs		State College	Raymond	Poplar-ville	Average
Variety	Hill	Valley		Hill		
Hi-Bred	719	738	483	482	447	574
Empire	681	696	513	414	432	547
Deltapine 14	716	715	429	424	414	540
Miller	680	729	485	405	360	532
Cleveland 54	639	764	531	371	282	517
Coker 100W-4	603	755	410	470	331	514
Stoneville 5A	579	711	466	434	335	505
Coker 100-9	557	668	408	423	399	491
Stoneville 2B	541	693	474	398	338	489
Bobshaw 1	534	679	453	408	317	478
Delfos 9169	534	723	469	403	234	473
Delfos 050	629	668	354	388	270	462
Delfos 9431	481	621	380	448	295	445
Bobdel	575	591	428	335	275	441
Boboak	570	608	394	343	218	427
Delfos 531C	480	592	363	368	305	422

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Tests of

Corn Hybrids and Varieties
IN MISSISSIPPI
1945

By

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and A. L. HAMNER

MISSISSIPPI STATE COLLEGE
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STATE COLLEGE MISSISSIPPI

CORN HYBRIDS AND VARIETIES IN MISSISSIPPI[1]

By ROBERT C. ECKHARDT, W. A. DOUGLAS.
and A. L. HAMNER[2]

Main Hybrid and Variety Tests

Corn performance tests designed to determine the most desirable strains, were continued in 1945 on five experiment stations in Mississippi. The most promising new hybrids from neighboring states were tested with the best open-pollinated varieties and older hybrids.

It is well recognized that open-pollinated varieties of corn differ greatly in adaptation and performance, but many farmers do not realize that some hybrids may be unsuited for planting in Mississippi, particularly hybrids that have been bred for conditions differing from those existing in the South. The performance tests of previous years have proven clearly that most northern hybrids are unsuited for use as full-season corns in the South because of poor husk extension and soft grain which makes them subject to serious insect damage. Only one northern hybrid, Pioneer 300, was included in the 1945 comparisons. It was included because a large amount of seed of it was offered for sale in the Delta in the spring of 1945.

Each test contained 25 entries arranged in a balance lattice square design with six replications. Each plot was 2 rows wide and 10 hills long with rows and hills usually spaced 40 inches apart. Four seeds were planted per hill and later thinned to two plants per hill, except at Stoneville. Stand percent at Stoneville is based on three plants per hill as a perfect stand. Some of these tests had fertilizer applied before planting and all tests received at least 32 pounds of nitrogen per acre.

Seasonal Conditions

The season of 1945 was an excellent one for corn, the State yield of corn in Mississippi averaging 20 bushels per acre, a 25 percent increase over 1944 and a 32 percent increase over the 10-year average, 1934-1943. Acre yields in all tests are high, but are indicative of what Mississippi can do in corn production when climate, cultural conditions, seed, and fertilizer are favorable.

Explanation of the Data Reported

Yields are based on 70 pounds of husked earcorn per bushel. Any two kinds of corn should differ by at least the number of bushels shown opposite the notation "Least significant difference (5 percent level)" before any great confidence can be placed on the two entries being really different in yielding ability.

The percentages of plants lodged are based on actual counts, all plants broken below the top ear-bearing node (joint) were classified as stalk lodged, while all plants leaning 30 degrees or more from the vertical were classified as root lodged. Husk length is reported as the estimated husk extension beyond the ear tip, in inches. Earworm damage ratings were made on the basis of the amount of feeding done by the insect, 0 indicating no feeding and 5 extreme feeding. All other notes are self explanatory.

State-Wide Results—Hybrids

Seventeen of the 25 entries were planted at all locations. The five station averages for these entries are reported in table 1. The top nine entries in yield were hybrids and the next to lowest was

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[1] Project AC-1 and PH-3 of the Mississippi Agricultural Experiment Station in cooperation with the Division of Cereal Crops and Diseases, Bureau of Plant Industry, Soils and Agricultural Engineering, and the Division of Cereal and Forage Insects, Bureau of Entomology and Plant Quarantine, Agricultural Research Administration, U. S. Department of Agriculture.

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[2] Agronomist, Bureau of Plant Industry, Soils, and Agricultural Engineering, and the Mississippi Agricutural Experiment Station; Entomologist, Bureau of Entomology and Plant Quarantine; and Associate Entomologist, Mississippi Agricultural Experiment Station, respectively.

Table 1. Summary of data from the main hybrid tests at Holly Springs, West Point, Stoneville, Natchez and Poplarville, 1945

Entry	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Weevil ears1/	Ear-worm	Ear ht.2/	Ears per plant	Husk length	Stand
	bu.	pct	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Miss. Exp. Hyb. 5111	71.1	52	36	12	22	1.4	5.2	1.7	2.2	92
La. 468	65.7	57	30	13	26	1.6	5.0	1.7	2.1	87
La. 1030	64.8	72	17	11	16	1.0	5.9	1.4	2.0	92
N. C. 5001	64.4	72	15	13	30	1.7	5.3	1.4	2.1	89
La. 502	63.3	48	36	16	15	1.3	5.6	1.8	2.5	78
N. C. 4003	63.0	67	11	22	37	1.5	5.0	1.6	2.0	90
Funk G714	62.3	61	9	30	46	2.1	5.3	1.5	2.2	90
Tenn. 10	62.1	70	18	12	50	2.5	4.9	1.5	1.9	98
N. C. 1028	60.5	68	10	22	51	1.7	4.8	1.5	1.9	87
*Station Mosby	58.7	61	25	14	35	1.9	5.7	1.1	2.1	94
*Jellicorse	57.8	60	24	16	39	2.1	4.5	1.4	2.0	90
*Station Laguna	57.2	62	20	18	42	1.9	5.9	1.1	2.0	92
N. C. 1032	57.1	74	8	18	39	1.6	4.8	1.5	1.9	87
N. C. 4004	55.4	68	17	15	38	1.6	4.9	1.3	1.9	80
N. C. 4026	53.8	73	9	18	30	1.5	4.5	1.5	2.0	82
Funk G708	51.4	56	15	29	47	2.2	4.8	1.2	2.0	89
*Jarvis (Sewell)	50.7	63	19	18	31	1.8	4.5	1.3	2.0	94

1/ Four-station av., West Point, Stoneville, Poplarville, and Natchez.
2/ Three-station av., Holly Springs, Stoneville, and Natchez.
* Open-pollinated varieties.

a hybrid. Mississippi Experimental Hybrid 5111 developed by the Mississippi Agricultural Experiment Station in cooperation with the U. S. Department of Agriculture was outstanding in yield, with an average of 71.1 bushels. Mississippi Experimental Hybrid 5111 also had good husk extension which gave good protection from weevils, and had less damage from corn earworms than most of the entries. Its main fault is its lack of lodging resistance. Mississippi Experimental Hybrid 5111 is closely related to Louisiana 468, since three of the four parental inbred lines are identical.

Louisiana 468 was second in yield. This hybrid has done well over a period of years and is adapted to the entire State. It has the same virtues and weaknesses as Mississippi Experimental Hybrid 5111.

Louisiana 1030 is a hybrid of mixed kernel color which is adapted to the southern half of Mississippi. It is the most earworm resistant hybrid we have tested, yields well, and stands well.

Of the North Carolina hybrids tested, N. C. 5001 seems most promising. It yields about 10 percent more than Station Mosby, stands better and has more resistance to rice weevils. N. C. 4003 also yields well, stands well, and is much lower eared than Mosby.

Two Funk hybrids were tested at all locations. Funk G714 is by far the better of the two, but it was no better than 7th in yield, stood no better than Mosby, and had the most stalk lodging of any entry. Funk G708 was exceeded in yield by all entries except Jarvis and had much stalk lodging. There seems little to recommend this hybrid, which was outyielded 14 percent by Station Mosby and 38 percent by Mississippi Experimental Hybrid 5111.

Open-Pollinated Varieties

Station Mosby, Station Laguna, and Jellicorse were very similar in performance, yielding well and standing better than some hybrids and poorer than others. It is apparent that these three varieties are better than poor hybrids, and the planter should be sure he buys seed of

Table 2. Summary of data from the main hybrid tests at Holly Springs, West Point, and Stoneville, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears[2]	Ear-worm	Ear ht.[1]	Ears per plant	Husk length	Stand
			Root	Stalk						
	bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Tx61M x L10[3]	84.3	64	25	11	14	1.6	5.2	1.6	2.2	87
Miss. Exp. Hyb. 5111	80.0	59	31	10	6	2.2	5.3	1.7	2.1	90
La. 468	74.7	63	24	13	9	2.4	5.0	1.7	1.9	87
N. C. 5001	73.5	82	11	7	12	2.6	5.6	1.4	2.1	92
La. 1030	72.6	79	15	6	4	1.6	5.9	1.4	2.1	93
N. C. 4003	72.3	80	6	14	15	2.3	5.2	1.6	1.9	91
La. 502	72.0	53	32	15	5	2.0	5.6	1.8	2.3	79
Funk G714	71.2	72	5	23	27	3.2	5.4	1.5	2.3	93
Tenn. 10	70.6	76	13	11	28	3.8	5.0	1.7	2.0	95
N. C. 1028	68.7	76	8	16	31	2.8	4.9	1.5	1.8	88
*Station Mosby	68.0	68	20	12	19	3.0	6.0	1.2	2.0	93
*Jellicorse	66.2	28	57	15	16	3.2	4.6	1.4	1.9	92
*Neal Paymaster	65.5	65	21	14	23	2.3	5.2	1.4	1.7	94
*Station Laguna	64.1	71	16	13	24	3.0	6.2	1.1	1.9	95
N. C. 1032	63.7	81	6	13	20	2.4	4.9	1.5	1.8	88
Tenn. 4004	62.1	84	14	2	43	2.5	4.6	1.0	1.2	93
N. C. 4004	61.9	76	13	11	11	2.6	4.7	1.4	1.8	82
Funk G708	60.8	78	10	12	28	3.4	5.0	1.2	1.9	92
N. C. 4026	60.6	85	5	10	11	2.4	4.6	1.6	1.9	82
Tenn. 4003	60.5	77	16	7	28	2.6	4.7	1.0	1.4	90
*Jarvis (Sewell)	58.7	69	21	10	8	2.6	4.6	1.4	1.9	97
*Deaton Corn	57.2	59	26	15	9	1.7	5.5	1.4	2.0	99
Pioneer 300[1]	53.8	97	0	3	58[4]	2.9	3.5	1.0	0.0	91

* Open-pollinated varieties.

[1] Two-station av., Holly Springs and Stoneville.

[2] Two-station av., West Point and Stoneville.

[3] Single-cross hybrid, female parent of Mississippi Experimental Hybrid 5111

[4] Stoneville average only.

Table 3. Summary of data from the main hybrid tests at Natchez and Poplarville, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears	Ear-worm	Ear ht.[1]	Ears per plant	Husk length	Stand
			Root	Stalk						
	bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Miss. Exp. Hyb. 5111	57.8	31	44	15	37	1.3	4.8	1.6	2.5	95
La. 1030	53.2	59	21	20	29	1.0	5.8	1.3	2.1	90
La. 468	52.2	48	40	12	44	1.6	4.8	1.6	2.4	86
N. C. 5001	50.8	58	20	22	47	1.7	4.8	1.4	2.2	84
La. 502	50.2	40	42	18	25	1.2	5.5	1.7	2.7	76
Tenn. 10	49.4	60	25	15	72	2.5	4.7	1.3	1.9	102
N. C. 4003	49.0	48	18	34	59	1.5	4.5	1.5	2.0	88
Funk G714	48.9	45	15	40	64	2.1	5.0	1.5	2.0	86
N. C. 1028	48.2	56	12	32	71	1.4	4.7	1.4	2.0	86
*Yellow Hastings	47.5	39	44	17	50	1.6	5.8	1.7	2.0	97
N. C. 1032	47.3	61	12	27	59	1.5	4.5	1.4	2.0	85
*Station Laguna	46.9	49	26	25	60	1.7	5.3	1.1	2.1	86
*Whatley Prolific	46.8	48	38	14	24	1.4	6.3	1.4	2.9	90
*Hastings Prolific	46.5	44	39	17	42	1.7	6.7	1.9	2.4	94
N. C. 4004	45.7	56	22	22	65	1.4	4.7	1.3	2.0	77
*Cockes Prolific	45.2	53	25	22	45	1.6	5.8	1.3	2.8	91
*Jellicorse	45.2	52	30	18	62	2.0	4.2	1.3	2.1	88
*Station Mosby	44.8	50	34	16	52	1.8	5.0	1.0	2.2	96
N. C. 4026	43.6	56	14	30	48	1.4	4.3	1.4	2.0	82
Jarvis (Sewell)	38.8	54	17	29	55	1.8	4.2	1.3	2.0	90
*Yellow Whatley	37.4	46	41	13	18	1.5	5.3	1.1	2.8	76
Funk G708	37.4	24	22	54	66	2.2	4.3	1.1	2.1	84
*Stewarts Corn	37.0	52	33	15	23	1.5	5.5	0.9	2.9	92

* Open-pollinated varieties. [1] Natchez average only.

Table 4. Main hybrid corn test, Holly Springs, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging		Ear-worm	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk					
	bu.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Miss. Exp. Hyb. 5111	69.6	88	1	11	2.0	5.0	1.7	2.0	96
La. 468	68.1	87	0	13	2.1	4.8	1.7	1.8	95
Tx61M x L10	67.6	82	0	18	2.2	5.8	1.5	2.0	93
N. C. 5001	64.6	92	0	8	2.1	5.0	1.3	1.8	94
*Station Mosby	61.9	94	0	6	2.4	5.2	1.2	2.0	89
Tenn. 4004	61.3	97	0	3	2.6	4.2	1.0	0.8	96
La. 502	60.5	82	2	16	1.9	5.3	1.8	2.0	80
N. C. 4003	60.4	91	0	9	2.0	4.7	1.5	1.8	95
Tenn. 4003	60.0	92	0	8	2.6	4.5	1.0	1.3	98
*Neal Paymaster	59.4	95	0	5	2.5	4.7	1.3	1.5	97
Tenn. 10	59.0	94	0	6	2.6	4.8	1.3	1.7	96
*Jellicorse	58.7	95	0	5	2.2	4.2	1.4	1.7	92
*Jarvis (Sewell)	57.5	91	0	9	1.9	4.3	1.5	1.8	97
N. C. 1028	57.4	88	0	12	2.4	4.8	1.4	1.7	88
N. C. 1032	57.1	95	0	5	2.2	4.7	1.4	1.7	95
La. 1030	56.8	96	0	4	1.7	5.3	1.3	2.0	93
N. C. 4026	55.2	93	0	7	2.2	4.3	1.5	1.8	85
Funk G708	54.9	88	0	12	2.4	4.8	1.1	1.8	95
Funk G714	54.6	75	0	25	2.7	5.0	1.5	2.0	88
N. C. 4004	53.2	90	0	10	2.3	4.7	1.2	1.5	83
*Deaton Corn	52.0	85	2	13	2.1	5.0	1.4	1.8	97
Pioneer 300	51.7	97	0	3	2.9	3.0	1.0	0.0	94
*Station Laguna	51.3	89	0	11	2.7	5.3	1.1	1.8	95

Least sig. dif. (5% level) 5.4

*Open-pollinated varieties.

Table 5. Main hybrid corn test, West Point, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears	Ear-worm	Ears per plant	Husk length	Stand
			Root	Stalk					
	bu.	pct.	pct.	pct	pct.	grade	no.	in.	pct.
Tx61M x L10	73.1	26	70	40	6	1.4	1.8	2.5	92
Miss. Exp. Hyb. 5111	69.4	28	68	4	4	1.4	1.8	2.2	97
La. 468	63.9	36	59	6	10	1.5	1.7	2.0	95
N. C. 5001	62.7	67	30	3	6	1.7	1.6	2.5	95
La. 502	62.7	22	76	2	4	1.4	1.8	2.8	88
Funk G714	62.4	74	11	15	14	2.0	1.7	2.7	92
N. C. 4003	60.8	77	16	7	18	1.6	1.6	2.0	90
La. 1030	60.2	56	42	2	2	1.0	1.4	2.3	98
Tenn. 10	58.7	62	35	3	32	2.6	1.5	2.2	97
N. C. 1028	58.3	68	21	11	34	1.8	1.6	2.0	95
*Station Laguna	55.6	58	34	8	14	1.7	1.1	2.0	99
N. C. 4026	55.1	78	15	7	14	1.6	1.5	2.0	95
*Neal Paymaster	54.5	35	56	9	14	2.4	1.4	1.8	93
N. C. 1032	52.6	73	17	10	14	1.5	1.5	2.0	89
*Jellicorse	52.2	26	55	9	11	2.3	1.4	2.0	93
N. C. 4004	51.1	57	37	6	8	1.7	1.4	2.0	91
Tenn. 4004	51.1	57	42	1	43	2.9	1.0	1.8	95
*Station Mosby	50.5	27	54	9	12	2.2	1.1	2.0	94
Tenn. 4003	50.0	51	47	2	21	3.0	1.0	1.3	90
Funk G708	46.8	67	28	5	25	2.3	1.2	2.2	91
*Jarvis (Sewell)	43.1	34	60	6	3	1.7	1.3	2.0	94
*Deaton Corn	42.2	27	61	12	5	1.8	1.3	2.2	97

Least sig. dif. (5% level) 5.7

*Open-pollinated varieties.

Table 6. Main hybrid corn test, Stoneville, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears	Ear-worm	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk						
	bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Tx61M x L10	112.2	85	4	11	22	1.2	5.5	1.7	2.0	76
Miss. Exp. Hyb. 5111	100.9	59	25	16	8	1.0	5.7	1.8	2.0	78
La. 1030	100.7	86	3	11	6	0.4	6.5	1.5	2.0	88
Funk G714	96.5	69	3	28	40	1.8	5.8	1.5	2.2	100
N. C. 4003	95.6	74	1	25	12	1.0	5.7	1.6	2.0	87
Tenn. 10	94.2	74	3	23	24	2.5	5.3	1.5	2.0	92
N. C. 5001	93.1	88	2	10	19	1.3	6.2	1.4	2.0	86
La. 502	92.9	54	19	27	6	0.7	6.0	1.8	2.2	70
La. 468	92.0	69	12	19	8	1.2	5.3	1.8	2.0	70
*Station Mosby	91.6	75	5	20	26	1.4	6.8	1.3	2.0	96
N. C. 1028	90.4	72	4	24	29	1.3	5.0	1.6	1.7	82
*Jellicorse	87.6	66	3	31	21	1.8	5.0	1.5	2.0	90
*Station Laguna	85.5	69	12	19	34	1.5	7.2	1.2	1.8	92
*Neal Paymaster	82.7	66	7	27	33	2.0	5.7	1.4	1.8	92
N. C. 1032	81.4	76	1	23	26	1.2	5.2	1.5	1.8	81
N. C. 4004	81.3	80	3	17	14	1.2	5.3	1.4	1.8	72
Funk G708	80.7	78	2	20	32	2.1	5.3	1.2	1.8	90
*Deaton Corn	77.5	65	14	21	14	1.2	6.0	1.4	2.0	103
*Jarvis (Sewell)	75.5	81	3	16	13	1.6	5.0	1.3	2.0	100
Tenn. 4004	74.0	96	1	3	43	2.2	5.0	1.1	1.0	87
Tenn. 4003	71.6	89	1	10	36	2.1	5.0	1.1	1.5	81
N. C. 4026	71.6	85	0	15	8	1.0	5.0	1.7	2.0	66
Pioneer 300	56.0	93	0	7	58	2.8	4.0	1.0	0.0	89

Least sig. dif. (5% level) 5.7

*Open-pollinated varieties.

Table 7. Main hybrid corn test, Natchez, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging		Weevil ears	Ear-worm	Ear ht.	Ears per plant	Husk length	Stand
			Root	Stalk						
	bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Miss. Exp. Hyb. 5111	68.7	85	4	11	22	1.1	4.8	1.6	2.7	102
Tenn. 10	58.9	90	1	9	58	2.3	4.7	1.3	2.0	115
La. 468	58.1	89	3	8	24	1.4	4.8	1.6	2.7	87
La. 1030	57.1	92	2	6	10	0.5	5.8	1.2	2.2	93
N. C. 1028	56.8	84	0	16	56	1.1	4.7	1.5	2.0	90
La. 502	56.4	78	5	17	11	0.9	5.5	1.7	3.2	71
N. C. 5001	56.1	93	0	7	25	1.4	4.8	1.4	2.3	84
Funk G714	55.4	73	4	23	39	1.7	5.0	1.5	2.3	82
*Station Laguna	54.6	87	2	11	38	1.5	5.3	1.1	2.2	89
N. C. 1032	53.9	93	0	7	34	1.3	4.5	1.4	2.0	87
*Yellow Hastings	53.8	77	5	18	42	1.3	5.8	1.7	2.0	104
*Hastings Prolific	53.6	83	3	14	24	1.3	6.7	1.9	2.5	104
*Jellicorse	53.5	88	1	11	55	1.7	4.2	1.3	2.0	88
*Whatley Prolific	51.5	89	4	7	2	1.0	6.3	1.3	3.0	98
N. C. 4004	50.5	91	0	9	49	1.2	4.7	1.3	2.0	72
N. C. 4003	50.5	84	1	15	41	1.3	4.5	1.4	2.2	87
*Cockes Prolific	50.4	91	3	6	21	1.2	5.8	1.1	3.0	97
*Station Mosby	49.8	90	4	6	24	1.8	5.0	0.9	2.3	98
N. C. 4026	46.0	88	0	12	31	1.2	4.3	1.5	2.0	80
*Jarvis (Sewell)	44.1	78	3	19	34	1.3	4.2	1.2	2.0	96
Funk G708	42.2	60	1	39	50	1.7	4.3	1.2	2.2	84
*Yellow Whatley	40.5	82	7	11	6	1.2	5.3	1.0	3.0	75
*Stewarts Corn	38.3	90	2	8	5	1.3	5.5	0.8	3.2	93

Least sig. dif. (5% level) 7.4

*Open-pollinated varieties.

a superior hybrid before he discontinues growing a good adapted variety.

Jarvis, as in years past, was the lowest yielding entry tested. It did best, relatively, at Holly Springs.

Performance data at the individual locations are shown in tables 4 to 8.

Varieties Planted only in South Mississippi

In addition to the entries planted at all stations, several varieties of corn were planted at Natchez and Poplarville (tables 2, 7, and 8), Cockes Prolific (N. E. La. Station), Hastings, Yellow Hastings and Whatley Prolific all yielded about the same as Station Mosby.

Varieties Planted in North Mississippi

A few hybrids and varieties were planted at Holly Springs, West Point, and Stoneville, in addition to those planted at

Table 8. Main hybrid corn test, Poplarville, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Weevil ears	Ear-worm	Ears per plant	Husk length	Stand
	bu.	pct.	pct.	pct.	pct.	grade	no.	in.	pct.
La. 1030	49.2	27	40	33	48	1.4	1.4	2.0	88
N. C. 4003	47.5	11	36	53	77	1.7	1.6	1.8	90
Miss. Exp. Hyb. 5111	46.8	0	82	18	53	1.5	1.6	2.3	88
La. 468	46.2	7	76	17	64	1.8	1.5	2.0	86
N. C. 5001	45.4	21	41	38	70	2.0	1.4	2.0	84
La. 502	43.9	1	79	20	40	1.5	1.7	2.2	80
Funk G714	42.4	17	26	57	90	2.5	1.4	1.8	90
*Whatley Prolific	42.0	7	72	21	46	1.7	1.6	2.8	82
N. C. 4026	41.2	24	28	48	66	1.7	1.4	2.0	85
*Yellow Hastings	41.2	2	82	16	58	1.9	1.8	2.0	90
N. C. 4004	40.9	22	43	35	82	1.6	1.3	2.0	82
N. C. 1032	40.7	30	23	47	84	1.7	1.5	2.0	83
*Cockes Prolific	40.0	14	47	39	69	1.9	1.4	2.5	85
*Station Mosby	39.9	9	64	27	80	1.9	1.1	2.0	94
Tenn. 10	39.8	29	50	21	86	2.7	1.4	1.8	89
N. C. 1028	39.5	26	25	49	86	1.8	1.4	2.0	81
*Hastings Prolific	39.4	5	75	20	61	2.1	1.9	2.3	85
*Station Laguna	39.2	10	51	39	83	1.9	1.1	2.0	83
*Jellicorse	36.9	14	60	26	70	2.4	1.2	2.2	87
*Stewart Corn	35.8	13	65	22	41	1.8	1.0	2.5	90
*Yellow Whatley	34.2	10	75	15	30	1.7	1.2	2.5	78
*Jarvis (Sewell)	33.5	30	31	39	76	2.2	1.3	2.0	84
Funk G708	32.5	0	44	68	83	2.6	1.1	2.0	85

Least sig. dif. (5% level) 4.5

*Open-pollinated varieties.

Table 9. Summary of variety tests at Holly Springs, Stoneville and Natchez, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Weevil Ears 1/	Ear-worm	Ear ht.	Ears per plant	Husk length	Stand
	bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Station Mosby	67.1	85	4	11	25	1.9	5.7	1.1	1.9	96
Graham Mosby	57.8	85	5	10	23	1.9	5.0	1.0	1.9	97
Sewell Jarvis	54.3	78	3	19	11	1.5	4.3	1.2	1.9	100
Johnston Jarvis	52.7	87	3	10	6	1.6	4.1	1.1	2.1	98
Carraway Prolific	52.5	74	5	21	5	1.5	4.8	1.1	2.5	98
Butler Mosby	52.3	75	13	12	6	1.5	5.9	0.9	2.5	97
Suttle Mosby	51.3	75	10	15	11	1.5	5.1	1.1	2.0	93
Gray Mosby	49.9	81	2	17	14	2.1	3.2	1.0	1.9	91
Holloman Cribfiller	44.8	64	3	33	10	2.0	2.5	1.2	2.0	85

1/ Two-station average, Stoneville and Natchez.

all stations (tables 3, 4, 5, and 6). Pioneer 300, a northern hybrid, was widely sold in the Delta and was tested at Stoneville and Holly Springs. It was by far the lowest yielding entry at Stoneville, hybrid or open-pollinated, and was next to lowest in yield at Holly Springs. Pioneer 300 is a single-eared hybrid of Corn-Belt type with no husk protection against birds or weevils. When the corn was harvested at Stoneville, over 50 percent of the kernels were weevily or rotten. Corn-Belt strains of this type have no place in Mississippi except for possible use as early feed.

Neal Paymaster, a good open-pollinat-

Table 10. Variety test, Holly Springs, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Ear-worm	Ear ht.	Ears per plant	Husk length	Stand
	bu.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Station Mosby	56.2	95	0	5	2.6	5.0	1.2	2.2	88
Sewell Jarvis	56.2	93	0	7	1.7	4.0	1.5	1.8	96
Graham Mosby	55.3	94	1	5	2.5	4.6	1.1	1.6	96
Gray Mosby	54.9	95	0	5	2.1	3.2	1.1	1.8	96
Johnston Jarvis	54.3	97	0	3	1.6	4.0	1.3	2.0	95
Suttle Mosby	52.4	90	1	9	2.0	5.0	1.3	2.0	90
Carraway Prolific	47.8	89	0	11	2.0	4.8	1.2	2.4	92
Butler Mosby	47.3	86	4	10	2.0	5.2	1.0	2.6	92
Holloman Cribfiller	46.8	89	0	11	2.2	2.4	1.3	1.4	83
Jarvis Jarvis	44.7	95	0	5	1.8	3.0	1.3	1.6	92

Least sig. dif. (5% level) 5.3

Table 11. Variety test, Stoneville, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Weevil ears	Ear-worm	Ear ht.	Ears per plant	Husk length	Stand
	bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Station Mosby	95.1	83	4	13	38	1.3	6.2	1.1	2.0	106
Graham Mosby	74.1	68	13	19	34	1.4	5.4	1.0	2.0	102
Butler Mosby	69.9	58	28	14	10	1.1	6.2	0.9	2.4	98
Sewell Jarvis	63.8	63	5	32	7	1.4	4.2	1.1	2.0	98
Gray Mosby	62.4	64	6	30	10	1.8	3.4	1.0	2.0	96
Suttle Mosby	61.4	62	24	14	18	1.3	5.4	1.1	2.0	94
Carraway Prolific	61.3	55	15	30	5	1.2	4.4	1.1	2.4	101
Johnston Jarvis	61.2	76	7	17	4	1.6	4.0	1.0	2.0	93
Holloman Cribfiller	50.8	44	8	48	5	1.8	2.2	1.1	2.0	88

Least sig. dif. (5% level) 6.0

Table 12. Variety test, Natchez, 1945.

Entry	Acre yield	Plants erect at harvest	Lodging Root	Lodging Stalk	Weevil ears	Ear-worm	Ear ht.	Ears per plant	Husk length	Stand
	bu.	pct.	pct.	pct.	pct.	grade	ft.	no.	in.	pct.
Station Mosby	50.0	79	7	14	12	1.8	5.8	1.0	1.6	94
Carraway Prolific	48.3	78	0	22	6	1.4	5.2	1.2	2.6	100
Graham Mosby	44.0	92	1	7	13	1.7	5.0	0.9	2.0	92
Sewell Jarvis	42.8	78	3	19	16	1.5	4.6	1.1	1.8	107
Johnston Jarvis	42.7	89	2	9	9	1.7	4.4	1.0	2.2	106
Suttle Mosby	40.2	72	5	23	4	1.3	5.0	1.0	2.0	96
Butler Mosby	39.7	81	7	12	2	1.2	6.4	0.8	2.6	100
Holloman Cribfiller	36.7	59	2	39	16	1.9	2.8	1.2	2.0	83
Gray Mosby	32.4	83	1	16	19	2.4	3.0	0.9	1.8	81

Least sig. dif. (5% level) 6.8

ed variety, yielded with the other good open-pollinated varieties, and 32 percent more than Pioneer Hybrid 300.

Variety Test

A number of open-pollinated varieties are being certified in Mississippi without regard to performance. In order to evaluate these and certain other open-pollinated varieties, tests composed entirely of open-pollinated varieties were grown at Holly Springs, Stoneville, and Natchez. The data are presented in tables 9, 10, 11, and 12.

Six strains of Mosby were grown. The data on one are omitted because of poor germination. Station Mosby was first in all three tests, and was 21 bushels better than the next strain of Mosby at Stoneville. Graham Mosby, used as the official Mosby by the Alabama Experiment Station, was next in yield. Gray Mosby was entirely different in plant type from any of the other Mosby's, being short and low eared.

Two strains of Jarvis were tested in the three tests and an additional strain tested at Holly Springs. Sewell Jarvis has been selected in Mississippi for a number of years and has lost much of the hard flinty characteristics of the original Jarvis. Johnston Jarvis also has been selected in the State for a number of years but still retains much of the Jarvis ear type. The Jarvis strain of Jarvis was purchased from Mr. Jarvis recently.

The Sewell and Johnston strains of Jarvis were very similar in yield while the Jarvis strain of Jarvis was much lower in yield. Both Sewell and Johnston Jarvis did relatively best at Holly Springs.

Carraway Prolific, a yellow Louisiana variety, did well at Natchez, and may be well adapted to South Mississippi.

Holloman Cribfiller is a white variety with very short plants and low ears. It is also short in yield.

It is apparent from these data that the strain or source of a variety is very important, and the general name Mosby or Jarvis, or any other varietal name means little unless one knows what strain is meant.

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Soybean Varieties and Dates of Planting in the Yazoo-Mississippi Delta

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Summary

Uniform soybean variety tests were located at Tunica, Stoneville, Anchorage, Satartia, and Onward in 1945. Yields, other agronomic data, and the chemical composition of the strains and varieties have been summarized according to maturity.

The strains C101 and S100 have yielded significantly more than Macoupin, a commonly known commercial variety of these strains maturing in early September. The variety, S100, is taller, produces seed of slightly higher quality and matures approximately 10 days later than C101. S100 is low in oil, while C101 is a good oil bean containing approximately 2 percent more oil than S100. One serious objection to these early maturing strains when grown in the Delta is the low quality of seed produced. In the past, Delta farmers have reported low germination of Macoupin due to adverse conditions encountered at harvest and during the storage period. It is expected that similar problems will prevail with these strains.

Ogden is definitely the highest yielding variety of those normally maturing between October 1 and 15. The 2-year average yield of this variety at Tunica, Stoneville, and Anchorage, was 34.5 bushels or 40 percent more than the next highest yielding variety. The chief objection to Ogden is that it shatters on certain soil types and under dry climatic conditions at harvest. It has been observed that shattering is more severe on light or droughty soils and on heavier soils of low fertility. Even on soils where shattering usually occurs, many farmers prefer Ogden to such non-shattering, lower yielding varieties, as Arksoy 2913 and Ralsoy.

In the breeding program under way at the Delta Station, plants coming out of crosses between Ogden and other varieties are being studied. It is hoped that strains carrying the high yield of Ogden and the non-shattering habit of Arksoy will be developed.

Of the varieties normally maturing the last half of October, Volstate and Roanoke, were equally productive. These varieties are similar in many respects and differ in that the oil content of Roanoke is slightly higher than that of Volstate. Both are non-shattering, erect growing, and of sufficient height to combine readily. Wood's Yellow has been quite productive in a number of locations in the Delta; however, it is low in oil and shatters under dry conditions. To farmers growing a large acreage of soybeans, the practice of planting the acreage to varieties of different maturity to increase the optimum combining period seems advisable, particularly in the production of soybeans for oil. The late maturing varieties have not been as productive or as high in content of oil as the better varieties of earlier maturity. The yields of strictly grain types, such as Mamotan, Mamloxi, Delsta, and Nanda have not been greatly different from those of the tall growing Louisiana strains, Acadian, L. Z., and Pelican. These late varieties are particularly well suited for interplanting in corn in that they usually mature after the corn crop is made. Appreciably lower seed yields were obtained from the hay varieties, Avoyelles, Gatan, Red Tanner, and from two vegetable varieties, Cherokee and Seminole.

SOYBEAN VARIETIES AND DATES OF PLANTING IN THE YAZOO-MISSISSIPPI DELTA[1]

By PAUL R. HENSON and ROBERT S. CARR[2]

Soybean variety and dates of planting tests have been conducted at the Delta Experiment Station, Stoneville, Mississippi, for a number of years. In 1943 the program of the U. S. Regional Soybean Laboratory [3] was enlarged to include 12 southern states with headquarters for the Southern section at Stoneville, Mississippi. As a part of this program, uniform variety tests have been conducted at a number of locations in the Yazoo-Mississippi Delta. The results of these variety tests and a study of the dates of planting at the Delta Station are reported herein.

Soybean Variety Tests in the Yazoo-Mississippi Delta

Uniform variety tests were again conducted at a number of locations on the Yazoo-Mississippi Delta to determine the adaptation of these varieties and strains to Delta conditions. Tests in 1945 were made in Tunica, Washington, Sunflower, Humphreys, Leflore, Yazoo, and Sharkey Counties.

Since the normal maturities of existing soybean varieties that may be adapted to the Delta range from mid-August to mid-November, the varieties were grouped according to their maturity in order to obtain more accurate information of the performance of each one. The grouping was as follows: (1) Early strains, maturing prior to September 15; (2) medium strains, October 1 to October 15; (3) medium-late strains, October 16 to November 1; and (4) late strains, which mature after November 1. At present there are no promising varieties which normally mature between September 16 and October 1. The origin of the varieties and strains included in the tests, grouped according to maturity is given in table 1.

Plant height and lodging notes were taken on the varieties as they matured. Yields were determined from the weight of seed harvested from a 16-foot section of the four one-row plots of each variety. All yields were analyzed statistically to determine whether the differences between varieties were significant. In this connection the two seasons at some locations were so different primarily in the amount and distribution of rainfall, that the yield and rank of some varieties was quite different. Because of this year-variety interaction, the differences required for significance between varieties in the 2-year averages are unusually high at some locations. Fair to excellent yields were obtained on all tests except those at Heathman and Greenwood. The Heathman test failed as a result of the extreme droughty condition at the time of planting. Livestock grazed the test at Greenwood destroying the comparative value of any yields.

Notes on seed quality and size were taken on each variety. A seed composite of each variety was taken for analysis. All analyses were made at the U. S. Regional Soybean Laboratory of Urbana, Illinois. Average yields for 1944 and 1945, the 1945 yields, other agronomic data, percentage of protein, percentage of oil, and iodine numbers of the oil, are sum-

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[1] Cooperative investigations between the U. S. Department of Agriculture; the Bureau of Plant Industry, Soils and Agricultural Engineering; the U. S. Regional Soybean Laboratory; and the Mississippi Agricultural Experiment Station.

[2] Agronomist and Assistant Agronomist, respectively.

[3] "An organization participated in by the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture, and the Agricultural Experiment Stations of Alabama, Arkansas, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Nebraska, North Carolina, North Dakota, Ohio, Oklahoma, South Carolina, South Dakota, Tennessee, Texas, Virginia, and Wisconsin."

Table 1. Origin of soybean varieties and strains.

Variety or strain	Source of originating agency	Origin
Early maturing strains		
Boone	Missouri Agr. Exp. Sta.	Sel. from P. I. 54563-3[1]
Chief	Illinois Agr. Exp. Sta.	Sel. from Illini x Manchu
Gibson	Purdue Agr. Exp. Sta.	Sel. from Midwest x Dunfield
Macoupin	Elmer Hulcher	Sel. from commercial lot
Patoka	Purdue Agr. Exp. Sta.	Sel. from P. I. 70218-2
C101	Purdue Agr. Exp. Sta.	Sel from Dunfield x Manchu
S55-10	Missouri Agr. Exp. Sta.	Sel. from Virginia x P. I. 37062
S55-35	Missouri Agr. Exp. Sta.	Sel. from Virginia x P. I. 37062
S100	Missouri Agr. Exp. Sta.	Rogue from Illini
Medium maturing strains		
Arksoy 2913	Ark. Agr. Exp. Sta.	Sel. from Arksoy
Armredo	Ariz. Agr. Exp. Sta.	Sel. from Mamredo
Magnolia	U. S. Dept. of Agr.	P. I. from 85537 from Suigen, China, 1929
Mamredo	Delta Exp. Sta., Stoneville, Miss.	Sel. from a cross (Mam. Yel. x Laredo)
Rose Non-Pop	W. P. Rose, Goldsboro, N. C.	Origin unknown
Ogden	Tenn. Agr. Exp. Sta.	Sel. from a cross (Tokyo x P. I. 54610)
P. I. 97066	U. S. Dept. of Agr.	Nanmen, Chosen, 1930
Ralsoy	Purina Mills, C. H. Banks	Sel. from Arksoy 2913
2-40A	Paul B. Hutchens	Sel from Arksoy
6-40M	Paul B. Hutchens	Sel. from a mixed seed lot
Delsoy	Delta Exp. Sta.	Sel. from P. I. 85355
Medium late maturing strains		
C. M. S.	J. E. Wannamaker, St. Matthews, S. C.	Sel. from Clemson
26-39M	Paul B. Hutchens	Sel. from a mixed seed lot
Missoy	U. S. Dept. of Agr.	P. I. 71664 from Nanking, China, 1927
Monetta	U. S. Dept. of Agr.	P. I. 71608 from Nanking, China, 1927
Roanoke	N. Car. Agr. Exp. Sta.	Sel. from mixed seed lot
Wood's Yellow	T. W. Woods & Sons	Sel. from Mammoth Yellow
Palmetto	U. S. Dept. of Agr.	P. I. 71587 from Nanking, China, 1927
P.I. 89775A	U. S. Dept. of Agr.	Tang Shang, China, 1930
Volstate	Tenn. Agr. Exp. Sta.	Sel. from a cross (Tokyo x P. I. 54610)
Late maturing strains		
Acadian	La. Agr. Exp. Sta.	Formerly La. 40-290
Avoyelles	La. Agr. Exp. Sta.	Sel. from Ototan
Cherokee	U. S. Dept. of Agr.	P. I. 93057 from Hangchow, China
Delsta	Delta Exp. Sta., Stoneville, Miss.	Station Sel. No. 6677, 1935
Gatan	Ga. Exp. Sta.	Sel. out of Ototan
L. Z.	La. Agr. Exp. Sta.	Formerly La. 40-400
Mamloxi	Delta Exp. Sta., Stoneville, Miss.	Sel. from a cross (Mam. Yel. x Biloxi)
Mamotan	Delta Exp. Sta.	Sel. from a cross (Mam. Yel. x Ototan)
Nanda	U. S. Dept. of Agr.	P. I. 95727 from Shariin, Chosen, 1932
Pelican	La. Agr. Exp. Sta.	
Seminole	U. S. Dept. of Agr.	P. I. 93058 from Hangchow, China

[1] Division of Plant Exploration and Introduction, Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. D. A.

marized by maturity groups in tables 2, 3, 4, and 5.

Tunica Tests

The most northern tests in the Delta were located in Tunica County, on Highway 61, in cooperation with Richard W. Owens, landowner, and D. D. Gibson, county agent. The soil, a Dubbs silt loam of high fertility is a major soil type of that section. No fertilizer was applied to the area in 1945. The land was thoroughly disked and the beans planted flat in 38-inch rows on May 4th. The varieties and strains of early, medium, and medium-late groups were tested in this location.

Of the early group, the Missouri strains, S100, S55-35, S55-10, and the Indiana strains C101 have all yielded well at Tunica, with S100 and C101 yielding equally high at Stoneville, the only other location at which this group was grown. Many of the early strains not only failed to provide sufficient ground cover to check weed growth, particularly in late summer, but are frequently too short to combine readily. In this connection, S100 provides fair ground cover and combines easily since it is a tall growing variety. All of these strains are lacking in seed quality. Chemical analyses of the seed show S100 to be lower in percent oil than the other varieties.

Ogden was again the highest yielding variety of those of medium maturity. This variety shatters on certain soil types under dry climatic conditions. Other good yielding varieties are Rose Non-Pop, Armredo, and Ralsoy. Delsoy yielded well but shattered badly. The protein and oil contents of the higher yielding varieties are relatively high with the exception of Delsoy, a variety definitely low in oil.

Volstate and the North Carolina strain, Roanoke, were the higher yielding varieties of those normally maturing between October 16 and November 1. Varieties of this maturity were not grown at Tunica in 1944.

Stoneville Tests

The tests on the Experiment Station at Stoneville were located on Robinsonville very fine sandy loam, commonly known to farmers in this vicinity as Deer Creek loam. It is a fertile soil, frequently producing in excess of one bale of cotton or 50 bushels of corn per acre. In 1945 the field was plowed, thoroughly disked, and the soybeans planted flat in 40-inch rows on May 22. The soybeans were not fertilized. The varieties and strains of all maturity groups were grown at Stoneville.

Relatively high yields were obtained in 1945 from all strains of the early group at Stoneville as shown in table 2. C101 and S100 are the leading varieties for the 2 years, 1944-45, with yields of 33.4 and 33.3 bushels per acre, respectively.

As at Tunica, the Ogden variety, maturing October 4. led the medium group with a 2-year average yield of 38.6 bushels, which was 11.9 bushels or 44 percent above that of the next highest yielding variety.

Of the varieties maturing at a medium-late date, i. e., October 16 to November 1, Roanoke, Volstate, and Wood's Yellow were the highest yielding at Stoneville in 1945. Wood's Yellow, however, shatters more and yielded significantly less than either of the other two varieties in 1944. Volstate and Roanoke have consistently been the highest yielding varieties of this maturity. The oil content of the seed of Roanoke is slightly higher than that of Volstate.

Grain or oil, hay, and vegetable types are included in the late group. None of the late varieties was outstanding in yield. Equally good yields were secured from the grain varieties, Manotan, Mamloxi, and Delsta. The Pelican, Acadian and L. Z., developed by the Louisiana Experiment Station, are intermediate grain-hay types and have given fair yields at Stoneville. The yields of grain from the hay varieties, Avoyelles, Gatan, and Red Tanner, are low for the group. Nanda, long considered a vegetable variety, was equal to the best of these varieties in content of oil and but slightly lower in yield. The vegetable varieties, Seminole and Cherokee, introductions from Hangchow, China, by the U. S. Department of Agriculture, are not particularly well adapted to Delta conditions.

Anchorage Tests

The tests at Anchorage, in Humphreys County, were located on a fertile Yazoo silt loam on the plantation of L. S. Stoner. Plantation yields of soybeans at this lo-

Table 2. Summary of agronomic and chemical data for the soybean strains of early maturity, 1944-45[1]

	C101	S100	S55-35	S55-10	Gibson	Chief	Macoupin	Boone	Patoka	Mean	Diff. required for sig. (.05)
2-yr. av. yields, 1944-45											
Tunica	28.8	30.3	28.7	28.1	27.1	25.8	25.2	23.8	—	27.2	Not sig.
Stoneville	38.0	36.3	31.7	31.5	31.0	30.5	29.5	28.0	—	32.1	5.9 bu.
Mean	33.4	33.3	30.2	29.8	29.0	28.1	27.4	25.9	—	29.6	3.9 bu.
1945 yields											
Tunica	28.3	34.2	28.8	27.7	27.3	27.7	25.1	22.9	27.8	27.8	6.0 bu.
Stoneville	33.8	32.6	32.0	30.3	29.5	31.2	24.5	24.1	36.9	30.5	5.6 bu.
Mean	32.0	33.8	30.4	29.0	28.4	29.4	24.8	23.5	32.3	29.3	4.3 bu.
2-yr. av., 1944-45											
Date mature	9-5	9-14	9-3	9-3	9-6	9-5	9-6	9-7	9-5	9-6	— —
Lodging[2]	2.6	2.6	2.4	2.9	2.9	2.9	2.5	3.3	1.6	2.6	— —
Height, inches	37	46	36	36	37	44	45	42	30	39	— —
Seed quality[3]	3.7	3.3	3.3	3.2	3.7	3.8	3.2	4.4	3.8	3.6	— —
Beans per lb.	3290	3660	3130	3500	3420	3730	3580	3520	3180	3446	— —
Percent protein[4]											
Tunica	40.1	40.7	42.3	41.9	40.3	40.5	38.8	41.1	40.5	40.7	— —
Stoneville	40.4	44.0	43.5	43.1	40.7	40.8	40.4	41.5	43.6	42.0	— —
Mean	40.3	42.4	42.9	42.5	40.5	40.7	39.6	41.3	42.1	41.4	— —
Percent oil[4]											
Tunica	21.4	20.1	20.7	21.5	21.4	21.7	22.3	21.5	21.3	21.3	— —
Stoneville	20.9	18.5	20.2	20.6	20.7	21.3	21.4	20.7	21.0	20.6	— —
Mean	21.2	19.3	20.5	21.1	21.1	21.5	21.9	21.1	21.2	21.0	— —
Iodine No. of oil											
Tunica	126.4	131.2	129.5	131.4	128.9	127.1	218.6	126.8	131.5	129.0	— —
Stoneville	131.3	130.7	131.9	134.2	130.5	129.3	130.1	125.3	132.6	130.7	— —
Mean	128.9	131.0	130.7	132.8	129.7	128.2	129.4	126.1	132.1	129.9	— —

[1] All chemical analyses made by the U. S. Regional Soybean Laboratory, Urbana, Illinois.

[2] Lodging notes recorded on a scale of 1 to 5 as: (1) Nearly all plants erect; (2) plants leaning slightly; (3) plants leaning moderately or 25 to 50 percent down; (4) plants leaning considerably or 50 to 80 percent down; (5) 80 percent or more of plants down.

[3] Seed quality recorded on a scale of 1 to 5 as: (1) Very good; (2) good; (3) fair; (4) poor; (5) very poor; based on development of seed wrinkling, damage, and color for the variety.

[4] Percentage based on moisture-free material.

Table 3. Summary of agronomic and chemical data for the soybean varieties and strains of medium maturity, 1944-45.[1]

	Ogden	Armredo	Ralsoy	2-40A	6-40M	Arksoy 2913	Mamredo	Magnolia	P. I. 97066	Rose Non-Pop	Delsoy	Mean	Diff. required for sig.
2-yr. av. yields, 1944-45													
Stoneville	38.6	25.6	25.7	26.7	22.5	20.8	23.0	26.2	24.5	25.6	24.0	25.7	5.0
Tunica	31.2	24.6	25.4	23.0	23.6	27.1	23.2	17.9	17.0	—	—	23.6	7.4
Anchorage	33.6	26.2	22.9	18.6	22.2	19.1	20.2	19.0	18.0	24.5	18.8	22.1	4.3
Mean	34.5	25.5	24.7	22.8	22.8	22.3	22.1	21.0	19.8	—	—	23.9	5.6
1945 yields													
Stoneville	26.7	20.1	16.2	20.3	14.4	16.0	15.7	21.0	20.1	23.9	17.6	19.3	4.2
Tunica	36.9	24.2	28.4	21.4	27.6	26.1	27.0	20.9	22.1	29.7	31.7	26.9	4.2
Anchorage	37.3	25.5	22.8	16.0	21.9	16.5	18.0	17.4	15.6	26.9	22.1	21.8	5.9
Onward	31.0	18.3	24.3	24.0	17.3	18.0	13.4	18.7	12.0	31.1	25.2	21.2	5.8
Mean	33.0	22.0	22.9	20.4	20.3	19.2	18.5	19.5	17.5	27.9	24.2	22.3	4.9
2-yr. av. data, 1944-45													
Date mature	10-2	10-5	10-3	10-5	10-5	10-4	10-7	10-4	10-11	10-9	10-6	10-5	—
Lodging[2]/	1.9	3.0	2.1	2.2	2.2	2.4	2.9	3.8	3.9	2.1	2.6	2.7	—
Height, inches	30	32	30	29	23	28	34	44	48	33	32	33	—
Seed quality[3]/	2.6	1.9	1.9	2.3	2.0	1.8	2.8	2.7	2.4	2.3	2.0	2.3	—
Seed per lb.	3310	4775	3780	3720	2930	4010	3690	3630	4360	3490	3360	3720	—
Percent protein[4]/													
Stoneville	41.7	40.0	42.9	42.7	44.1	43.0	40.8	43.2	43.6	42.4	44.8	42.4	—
Tunica	39.5	39.9	41.9	40.7	41.0	41.6	39.4	41.6	41.7	—	—	40.8	—
Anchorage	41.6	40.3	43.3	42.8	42.2	43.6	41.7	43.6	42.6	39.9	43.0	42.4	—
Mean	40.9	40.1	42.7	42.1	42.4	42.7	40.6	42.8	42.6	—	—	41.9	—
Percent oil[4]/													
Stoneville	19.8	19.9	19.8	19.6	18.6	19.7	19.6	20.4	18.3	19.4	17.1	19.5	—
Tunica	21.7	20.4	20.7	21.4	20.6	20.8	20.4	21.0	20.0	—	—	20.8	—
Anchorage	21.5	20.4	20.8	21.1	20.4	20.6	20.2	21.1	19.9	21.1	18.8	20.7	—
Mean	21.0	20.2	20.4	20.7	19.9	20.4	20.1	20.8	19.4	—	—	20.3	—
Iodine No. of oil													
Stoneville	138.2	135.5	136.0	135.0	131.6	136.2	132.8	130.3	132.7	133.4	131.6	134.3	—
Tunica	134.1	133.6	133.2	132.2	127.9	133.3	129.4	129.2	131.0	—	127.9	131.5	—
Anchorage	130.8	132.9	131.0	128.8	125.6	131.9	125.9	125.8	126.9	128.4	131.0	128.8	—
Mean	134.4	134.0	133.4	132.0	128.4	133.8	129.4	128.4	130.2	—	—	131.5	—

See footnotes, table 2.

cation have been well above the average for the Delta in past years. The test area was thoroughly prepared and planted flat in 38-inch rows on May 3. The varieties and strains of the medium and medium-late groups were grown at Anchorage.

In the medium group, Ogden, with a yield of 33.6 bushels led all other varieties by more than 10 bushels per acre as shown in table 3. The 2-year average yield of Ogden of 37.4 bushels per acre, as compared to 26.3 bushels for the next highest yielding variety, is indicative of the superiority of Ogden.

In the medium-late group, table 4, the yields of Volstate and Roanoke were significantly greater than that of any other variety in the group. The 2-year average of these two varieties was slightly less than 30 bushels per acre.

Satartia Tests

The tests at Satartia, in Yazoo County, were located on Vicksburg silty clay loam, and conducted in cooperation with M. F. Cresswell, landowner, and A. R. Ruby, county agent. The medium-late and late groups of varieties were grown at this location. The area was thoroughly disked and the tests planted flat in 40 inch rows on May 3. The level of fertility of this soil is high, usually producing in excess of a bale of cotton per acre.

In the medium-late group Roanoke made the greatest yield, 38.7 bushels per acre. Wood's Yellow and Volstate ranked second and third, with yields of 31.3 and 29.7 bushels, respectively. In the late group, table 5, yields of Mamloxi, Mamotan and Nanda were approximately the same and were significantly greater than yields of the other varieties.

Onward Test

The test at Onward, in Sharkey County, was located on Sharkey clay commonly known as "buckshot," on the Reality Plantation of J. H. Hand, Jr. The medium and medium-late groups were planted at this location. The land was well prepared and the soybeans planted flat in 40-inch rows on June 1.

In the medium group, as given in table 3, Ogden and Rose Non-Pop made significantly greater yields than that of all other varieties. These were approximately 10 bushels greater than the average for the test. The highest yielding varieties in the medium-late group for this one year were Wood's Yellow, Roanoke, and Volstate; however, all yields were relatively low. Wood's Yellow was lower in percent oil than the other two varieties.

Dates of Planting Soybeans

Each year a part of the soybean acreage in the Delta is planted on a poorly prepared seedbed, frequently too dry for prompt germination, because of the possibility of not getting soybeans planted in time for maximum production. The stands secured from such plantings are usually thin and weedy. Poor stands result in lower yields at higher costs, because of the necessity for additional hand labor for hoeing. The Delta Experiment Station has for a number of years con-

The date of planting test, as planned ducted dates of planting tests to determine the best period for planting soybeans. for 1945, consisted of four replications of five varieties of soybeans to be planted at 3-week intervals beginning April 2 and continuing through July 16. Excessive rains in late March and early April delayed the first planting until April 13. The next planting was delayed accordingly for better adjustment of the time intervals between the first three plantings. The five varieties planted at each date were S100, Arksoy 2913, Ogden, Volstate, and Acadian; these varied in normal maturity from early September for S100 to early November for Acadian. Plant height and lodging notes were taken as the varieties approached maturity. Yields were based on harvested weight of seed from a 16-foot section from each row. Notes were taken on the threshed samples to record the effect of date of planting on seed quality and size. Samples of seed were composited by variety and date of planting for chemical analysis. Yields

Table 4. Summary of agronomic and chemical data for the soybean varieties and strains of medium-late maturity, 1944-45[1]

	Roanoke	Volstate	Wood's Yellow	26-39M	89775A	Missoy	CNS	Monetta	Palmetto	Mean	Diff. required for sig.
2-yr. av. yields, 1944-45											
Stoneville	34.8	32.8	28.1	26.9	23.9	22.0	20.5	20.9	14.1	24.9	11.4
Anchorage	28.1	29.3	19.5	20.7	14.1	14.8	13.2	12.1	10.3	18.0	11.0
Mean	31.5	31.1	23.8	23.8	19.0	18.4	16.9	16.5	12.2	21.5	10.1
1945 yields											
Tunica	34.7	38.4	27.1	30.0	24.7	22.7	14.1	17.1	23.4	25.8	4.7
Satartia	38.7	29.7	31.3	26.0	21.1	23.1	22.1	17.2	19.3	25.4	5.5
Stoneville	26.7	28.1	27.3	21.1	20.9	18.3	19.2	20.0	16.1	22.0	6.0
Anchorage	34.5	35.6	24.5	19.6	10.5	19.6	15.2	12.2	16.1	20.9	9.0
Onward	17.8	17.7	19.5	13.9	16.3	11.9	13.0	11.8	12.2	14.9	5.2
Mean	30.5	29.9	25.9	22.1	18.7	19.1	16.7	15.7	17.4	21.8	4.9
2-yr. av. data, 1944-45											
Date mature	10-23	10-25	10-23	10-18	10-16	10-20	10-22	10-14	10-22	10-20	—
Lodging[2]	3.3	3.4	2.3	2.8	3.7	4.3	3.4	3.8	4.3	3.5	—
Heights, inches	41	37	38	26	46	55	34	40	59	43	—
Seed quality[3]	1.9	1.9	2.4	1.9	3.1	2.8	2.2	2.3	3.2	2.4	—
Seed per lb.	3260	3150	2480	3410	3750	4010	3600	4320	3170	3460	—
Percent protein[4]											
Stoneville	39.1	39.6	43.4	42.6	43.6	43.8	46.7	44.1	45.5	43.2	—
Anchorage	41.7	39.0	43.1	43.6	42.7	43.9	45.7	44.4	46.2	43.4	—
Mean	40.4	39.3	43.3	43.1	43.2	43.9	46.2	44.3	45.9	43.3	—
Percent oil[4]											
Stoneville	21.3	20.5	19.1	18.5	18.5	19.1	17.8	15.8	17.4	18.7	—
Anchorage	22.1	21.7	18.5	18.4	19.2	19.2	17.8	15.7	17.8	18.9	—
Mean	21.7	21.1	18.8	18.5	18.9	19.2	17.8	15.8	17.6	18.8	—
Iodine No. of oil											
Stoneville	135.2	131.6	132.2	136.9	135.3	129.0	130.8	134.5	127.9	132.6	—
Anchorage	129.4	130.7	128.2	131.2	131.0	128.3	128.3	131.3	127.5	129.5	—
Mean	132.3	131.2	130.2	134.1	133.2	128.6	129.6	132.9	127.7	131.1	—

See footnotes, table 2

Table 5. Summary of agronomic and chemical data for the soybean strains of late maturity, 1944-45 1/

	Mamo-tan	Mam-loxi	Delsta	Pelican	Acadian	Nanda	L. Z.	Avoy-elles	Gatan	Semi-nole	Chero-kee	Red Tanner	Mean	Diff. required for sig.
Average yields in bushels per acre, 1944-45														
Stoneville	29.0	25.7	25.7	25.6	25.5	23.7	23.6	17.2	15.8	12.7	12.4	—	21.5	8.1
Average yields in bushels per acre, 1945														
Stoneville	28.1	31.1	28.8	26.5	24.9	23.5	26.8	17.4	14.3	16.2	16.3	9.9	22.0	5.2
Satartia	32.4	33.3	24.3	23.2	25.0	30.5	20.6	16.3	17.1	15.0	17.1	19.2	22.8	5.8
Mean	30.3	32.2	26.6	24.9	25.0	27.0	23.7	16.9	15.7	15.6	16.7	14.6	22.4	6.9
2-yr. av. data, 1944-45														
Date mature5/	10-30	11-1	10-28	11-1	10-29	10-28	10-30	10-30	10-30	11-2	10-30	10-20 6/	—	—
Lodging2/	3.0	3.1	2.9	4.3	4.1	3.4	4.1	4.5	4.5	3.9	3.2	5.0	—	—
Height, inches	43	45	47	60	60	39	60	56	57	46	49	35	—	—
Seed quality3/	2.1	2.4	2.2	2.2	2.0	2.3	2.4	2.5	2.0	3.4	2.7	3.4	—	—
Beans per lb.*	2500	2800	2100	3800	3200	2400	3700	3600	4400	1600	2200	3900	—	—
2-yr. av. Stoneville, 1944-45														
Percent protein	41.8	42.7	42.7	41.6	43.3	42.1	44.0	42.5	45.0	45.7	46.6	—	43.5	—
Percent oil	19.6	18.2	19.2	19.8	19.8	20.4	19.3	18.3	16.9	19.3	18.0	—	19.0	—
Percent protein, 1945														
Stoneville	42.2	43.2	42.7	40.5	43.4	43.3	43.8	41.9	45.4	46.5	46.9	46.3	43.8	—
Satartia	41.2	43.0	40.3	41.4	41.8	41.0	41.1	39.4	41.1	44.2	44.4	44.2	41.9	—
Mean	41.7	43.1	41.5	41.0	42.6	42.2	42.5	40.7	43.3	45.4	45.7	45.3	42.9	—
Percent oil, 1945														
Stoneville	18.8	18.1	18.5	19.4	19.0	19.2	18.7	18.1	16.4	18.6	17.7	16.1	18.2	—
Satartia	19.4	18.8	19.7	20.9	20.2	20.0	19.4	19.0	18.1	20.1	18.3	17.2	19.3	—
Mean	19.1	18.5	19.1	20.2	19.6	19.6	19.1	18.5	17.3	19.4	18.0	16.7	18.8	—
Percent Iodine, 1945														
Stoneville	138.5	137.3	135.1	137.4	136.3	133.3	136.9	137.8	138.8	135.1	133.5	140.3	136.7	—
Satartia	135.4	136.0	131.7	136.3	135.0	129.8	136.5	137.7	137.7	131.7	133.6	138.3	135.0	—
Mean	137.0	136.7	133.4	136.9	135.7	131.6	136.7	137.8	138.3	133.4	133.6	139.3	136.0	—

1/, 2/, 3/, and 4/, See footnotes, table 2.

*1945 average for Stoneville and Satartia.

5/Stoneville only.

6/1945 only

were not taken on the varieties planted July 16 because of poor stands. The stands of Acadian planted June 24 were so badly damaged by rabbits that comparable yield data could not be obtained of this variety.

The 1945 average yields of the varieties at each date of planting are given in table 6. These yields closely substantiate the results of tests of previous years. Since these results are more complete than previous years data, only the data for 1945 are given. Each variety yielded equally well at the different planting dates from April to early June, although the data indicate slightly lower yields from the planting of June 4. The yields of all varieties planted June 25 were significantly lower than those of earlier plantings.

Since the results show but small differences in yield between early April to early June plantings, it is of interest to note the effect of date of planting on the maturity of the various varieties. The 2-year data as given in table 7 is very interesting in this regard. The maturity of the early variety, S100, was affected much more by date of planting than the later varieties. The differences in maturity dates between early and late plantings was 26 days for S100 and 18, 6, and 2 days for Ogden, Arksoy, and Volstate, respectively. It is of particular interest to note that Ogden in the early plantings matured 5 days ahead of Arksoy and 7 days later when planted June 4. The spread in maturity of Ogden from early to late plantings of 18 days suggests the possibility of planting this variety at different dates to increase the length of the combining period. Such a practice would be a desirable one for Delta farmers, since Ogden in particular does shatter under very dry conditions if not combined promptly.

Late plantings usually result in shorter, more erect plants. The later plantings in 1945, because of well distributed rainfall in July through September, were as tall and lodged to the same degree as the earlier plantings. The results also indicate better seed quality from later plantings. Chemical analyses of the seed of the varieties have indicated a slight decrease in oil content with the later plantings. The oil content of seed from late

Table 6. Effect of date of planting on yield of soybeans, Stoneville, Mississippi, 1945.

Date of planting	Average yields (Bu. per acre)					
	S-100	Arksoy 2913	Ogden	Volstate	Acadian 1/	Mean
April 13	35.4	27.8	33.2	31.6	30.4	32.0
May 1	35.8	26.7	30.5	34.3	26.5	31.8
May 15	33.8	26.3	31.5	31.3	22.4	30.7
June 4	28.0	24.3	32.4	29.1	22.7	28.5
June 25	14.1	13.5	15.7	23.3	—	16.7
Mean	29.4	23.7	28.7	29.9	—	—

Difference required for significance (5% level): Between date: 4.2 bushels.
Between varieties: 3.0 bushels

1/ Not included in the mean.

Table 7. Effect of date of planting on the maturity of four varieties of soybeans, 1944-1945, Stoneville, Mississippi

Date planted	Average date mature			
	S-100	Ogden	Arksoy	Volstate
April 13	Sept. 5	Sept. 30	Oct. 5	Oct. 27
May 1	Sept. 10	Oct. 6	Oct. 6	Oct. 28
May 15	Sept. 17	Oct. 8	Oct. 7	Oct. 28
June 4	Oct. 1	Oct. 18	Oct. 11	Oct. 29
Spread in maturity	26 days	18 days	6 days	2 days

June and July plantings has been consistently low.

In conclusion, the dates of planting tests have shown that soybeans may be planted from early April to early June with equally good results. This long planting period should enable Delta farmers to readily fit soybeans into their planting schedules. The results indicate the optimum combining period of the Ogden variety of soybeans can be increased by early and late plantings.

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Cotton Production Costs in Northeast Mississippi 1944

By

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Cotton Production Costs in Northeast Mississippi, 1944

By W. J. EDENS

Much is known about growing cotton, and much is known about the marketing of cotton, but little is known concerning the actual cost of producing this crop by the vast majority of farmers who produce it.

Most of the farmers in Northeast Mississippi produce cotton. In fact, cotton has been the principal income crop since the area was settled. Yet the many who have farmed the soils of Northeast Mississippi and throughout the South, have seldom kept records to compare the costs with market prices, when the margin between these two values mean so much to the well-being of the farmer and his family.

It was with the idea of learning the cost of producing cotton, and some of the farm management problems confronting farmers in its production, that an attempt was made by the Mississippi Agricultural Experiment Station in 1944 to get some farmers in several counties of Northeast Mississippi interested in keeping records necessary to determine cost of producing this crop.

This article is based on a larger study of farm costs and farm management practices where much emphasis was placed on the production of milk. The Kraft Cheese Company was interested in this kind of work and helped finance it.

Farms selected for keeping records were located in three of the State's major soil areas, namely: Northeast Highland, Northeast Prairie, and Pontotoc Ridge. The farms who kept records were located in the counties of Alcorn, Prentiss, Lee, Chickasaw, and Noxubee. Farms keeping records were further selected on the basis of emphasis placed on the production of cotton and milk, and farm types were so designated.

Farms with a large number of cows compared with the number of acres in cotton comprised one group, or **dairy-cotton** farms. Where the number of acres in cotton was large in proportion to the number of cows, the farm type was designated **cotton-dairy.** The farms having about the same number of cows as acres in cotton constituted the third type, or **dairy & cotton.** Of the 40 farms keeping records, 16 were dairy-cotton, 12 were cotton-dairy, and 12 were dairy & cotton. Thirty-two of the farms produced cotton and all 40 produced market milk.

Items of Cost

A study of table 1 shows the amount of cost items for the average cotton enterprise on 32 farms. The average cost of each item is shown for the total cotton enterprise, one acre of seed cotton, one 500-pound bale and seed, 500 pounds of lint, total lint, total seed, the cost of producing one pound of lint, and the proportionate part each item of cost was of the total cost of producing one pound of lint. Items of cotton cost are discussed in the following paragraphs.

Man labor. It will be observed, table 1, that man labor was the largest item of costs in producing cotton. The total-man-labor cost for the average cotton enterprise on 32 farms in Northeast Mississippi was $1,089. This labor cost was $50 per acre of cotton grown, $51 per 500 pound bale and seed, and $40 per 500 pounds of lint. Man-labor cost per pound of lint was 8.04 cents, which constituted 60.5 percent of the total cost to produced 1 pound. Consequently, any steps taken by farmers to reduce the cost of producing cotton will necessarily include the consideration of man-labor.

The man labor required to grow an acre of cotton amounted to 141 hours, and only 3 hours more were required to produce a 500-pound bale since production was so near 1 bale per acre. The range in hours required per acre of cotton on the 32 farms was from 63 hours

Table 1. Production, values, and average costs and returns per farm for cotton on 32 farms in Northeast Mississippi, 1944.

		Production:		Values (Dollars recevied):	
		Total seed cotton	26,109 lbs.	Total seed cotton	2,646.14
Cotton acres	21.77	Total lint	10,671 lbs.	Total lint,	2,263.72
Bales ginned	20.23	Total seed	15,438 lbs.	Lint per pound	0.2121
Man hours per acre	141	500 lb. bales	21.38 b/c	Total seed	382.42

Item	Total crop	One acre seed cotton	One 500 lb. bale and seed	500 lbs. of lint*	Total lint*	Total seed	Lint	
							Per lb.*	Percent of total
	dol.	dol.	dol.	dol.	dol.	dol.	cents	pct.
Costs:								
Land	67	3.08	3.14	2.47	53	14	0.50	3.7
Fertilizer	107	4.92	5.01	3.95	84	23	0.79	6.0
Manure	38	1.76	1.80	1.42	30	8	0.28	2.1
Seed	43	1.97	2.01	1.59	34	9	0.32	2.4
Man labor	1,089	50.02	51.02	40.18	857	231	8.04	60.5
Horse labor	195	8.95	9.13	7.19	153	41	1.42	10.8
Tractor	22	1.01	1.02	.81	17	5	0.16	1.2
Other equipment	54	2.48	2.53	1.99	43	12	0.40	3.0
Ginning	108	4.96	5.06	3.98	85	23	0.80	6.0
Miscellaneous	77	3.53	3.60	2.84	61	16	0.57	4.3
Total cost	1,800	82.68	84.32	66.40	1,417	382	13.28	100.0
Returns:								
Total lint	2,264	104.01	106.07					
Total seed	382	17.57	17.92					
Total returns	2,646	121.58	123.99	106.07	2,264	382	21.21	
Gain	846	38.90	39.67	39.67	846	0	7.93	

*Cost of lint cotton is determined by the total costs of seed cotton minus total value (amount received) of seed.

to 176 hours. Barring the fact that there were differences in the yield per acre among farms, there still would be much room for increasing the efficiency of labor. And since this cost item was 60.5 percent of the total cost of production, farmers could well look to using available labor on the farm, as well as hired labor, to a more distinct advantage.

Horse labor. Labor performed by workstock held the second place in magnitude of cost. Horse labor used to produce cotton averaged $195 per farm, or $8.95 per acre. The cost of horse labor to produce 1 pound of lint cotton was 1.42 cents or 10.8 percent of the total cost to produce 1 pound.

Land. Land costs (interest on investment, taxes, improvements) per farm for the cotton enterprise on 32 farms in Northeast Mississippi was $67. This amounted to $3.08 per acre, and $3.14 per 500-pound bale and seed. The land cost per 500-pound bale of lint was $2.47 and the average cost per pound of lint was $0.005. This land cost of one-half cent per pound of lint was 3.7 percent of the total cost to produce a pound of lint. The average value per acre of land only for the 32 farms was $23.96, and the total farm investment per acre was $63.20.

Fertilizer. All but six of the 32 farms used fertilizer in the production of cotton. Fertilizer costs for cotton were $107 per farm, or $4.92 per acre. This was considerably more than the annual cost of land per acre. The fertilizer expense per pound of lint was 0.79 cents, or 6 percent of the total cost of 13.28 cents to produce a pound of lint.

Manure. Twenty-six of the 32 farms growing cotton applied manure in its production. The amount used was very small, since the average value of manure applied per acre on farms growing cotton was only $1.76, or $38 per farm. Thus, the manure cost per pound of lint cotton was 0.28 cents. This was 2.1 percent of the total cost of producing one pound of lint.

Cottonseed. Cottonseed for planting cost $43 per farm and $1.97 per acre of cotton. This expense amounted to 0.32 cents per pound of lint and 2.4 percent of the cost of producing one pound of lint.

Tractor expense. Tractor expense for producing cotton averaged $22 per farm for the farms growing cotton. Seventeen of these farms owned tractors. Since the average cost per hour for operating tractors was 49 cents, it is readily seen that the tractors were used only for a few hours on the cotton enterprise. When tractors were used, it was principally for plowing early in the year.

Other equipment. Other equipment consisted of all equipment on farms except tractors. This cost averaged $54 per farm, or $2.48 per acre for the equipment used in producing cotton. Equipment cost per pound of lint amounted to 0.40 cents or 3 percent of the total cost to produce 1 pound of lint.

Ginning. The expense of ginning averaged $108 per farm and $4.96 per acre of cotton. The cost averaged $5.06 per 500-pound bale. This charge was fairly standard in all communities. Ginning cost was 0.08 cents per pound of lint and 6 percent of the total cost to produce 1 pound of lint. This cost per pound of lint was twice that of farm equipment and almost twice the annual cost of land. As an expense of production, ginning came next in importance after man- and horse-labor costs.

Miscellaneous costs. Miscellaneous costs amounted to $3.53 per acre and 0.57 cents per pound of lint. This expense was 4.3 percent of the total cost of producing 1 pound of lint.

Total costs of producing cotton. The average cost of producing the cotton enterprise on each of the 32 farms was $1,800, which amounted to $83 per acre. See table 1. The cost to produce 500 pounds of lint was $66, which gave a cost of 13.28 cents per pound. The return from one acre of cotton for lint and seed was $104 and $17.57, respectively.

The total return from the enterprise per farm was $2,646, thereby leaving a profit of $846 for the cotton enterprise and $38.90 per acre produced. With a cost per pound of lint at 13.28 cents and an average price of 21.21 cents received per pound, this gave a profit of 7.93 cents per pound of lint to the farmers growing cotton.

Costs of Cotton Production on Different Type Farms

Table 2 shows the average amount of cotton produced per farm for 32 farms in Northeast Mississippi as well as the amounts produced on dairy-cotton, cotton-dairy, and dairy & cotton farms. Items of cost of production are also given.

There was much variation in the acreage devoted to cotton production on the three types of farms. Range was from 9.1 acres per farm on dairy-cotton farms to 39.9 acres on cotton-dairy farms. Dairy & cotton farms produced 12.1 acres, which was only 3 acres more than was produced on dairy-cotton farms, and less than one-third of the acres grown on cotton-dairy farms. The number of acres produced on the five low-cost farms and the five high-cost farms was about the same, and approximately the same as was produced on dairy & cotton farms.

The items of cost in the production of cotton varied considerably in value for the three types of farms. Man-labor per acre, the most important cost item, was least on dairy-cotton farms and most on cotton-dairy farms, $28 and $54, respectively. This cost was $49 per acre on dairy & cotton farms. Horse-labor costs followed the same pattern. The low cost of man-labor to produce an acre of cotton on dairy-cotton farms probably was due more to the smaller yield of cotton

Table 2. Acres in cotton, bales produced, and the costs and returns per acre for cotton on 32 farms in Northeast Mississippi, 1944.

Item	Average	Dairy-cotton	Cotton-dairy	Dairy and cotton	Five low cost farms[1]	Five high cost farms[1]
Number of farms	32	8	12	12	—	—
Acres in cotton, per farm	21.8	9.1	39.9	12.1	12.10	13.90
500 lb. bales produced	21.3	6.0	40.3	12.6	13.83	10.77
500 lb. bales per acre	.98	.67	1.01	1.04	1.14	.78
Man hours per acre	141	112	151	120	113	122
Costs:						
Land	$3.08	$3.37	$3.19	$2.59	$3.26	$2.42
Fertilizer	4.92	2.39	5.32	4.83	5.33	4.61
Manure	1.76	3.03	0.91	3.92	2.01	4.10
Seed	1.97	2.30	1.66	2.85	2.63	2.05
Man labor	50.02	28.15	53.68	48.89	37.42	44.55
Horse labor	8.95	7.88	9.18	8.71	6.23	9.95
Tractor	1.01	0.62	1.08	0.94	1.20	1.71
Other equipment	2.48	3.62	2.31	2.46	2.01	2.13
Ginning	4.96	3.56	5.05	5.36	5.80	3.95
Miscellaneous	3.53	1.96	3.86	3.25	2.52	5.37
Total costs	82.68	56.88	86.24	83.80	68.41	80.84
Cost per lb. of lint	13.28	13.31	13.55	12.42	8.24	17.17
Returns:						
Lint	$104.01	$71.27	$106.42	$112.38	$122.11	$84.94
Seed	17.57	12.44	17.86	19.16	21.32	14.28
Total returns	121.58	83.71	124.28	131.54	143.43	99.22
Profit	38.90	26.83	38.04	47.74	75.02	18.38
Labor return per acre	88.92	54.98	91.72	96.63	112.44	62.93

[1] Based on cost per pound of lint.

per acre than to more efficient use of labor on dairy & cotton farms.

Fertilizer costs varied from $2.39 per acre on dairy-cotton farms to $5.32 on cotton-dairy farms. The five farms producing cotton at the least cost per pound used $5.33 worth of fertilizer per acre. The total cost of producing a pound of lint on the three types of farms did not vary much, but was least on the dairy & cotton farms. See table 2. It will be seen that the cost of production per pound on the five low cost farms was only 8.24 cents, while on the five high cost farms the cost to produce 1 pound of lint was 17.17 cents.

Cotton Returns On Different Type Farms

Total returns per acre of cotton were the smallest on dairy-cotton farms. See table 2. This is largely the reflection of a low yield per acre for this type of farming. The average return per acre for all types was $122; for dairy-cotton, $84; for cotton-dairy, $124; and for dairy & cotton, $132. Profits per acre were $39, $27, $38, and $48, respectively. The five farms producing cotton at the lowest cost per pound—8.24—had a profit of $75 per acre; whereas, $18.38 was the profit per acre on the five farms producing cotton at the highest cost per pound, which was 17.17 cents.

Considering returns and profits as a whole, it appears that the yield per acre was the most important factor determining the cost to produce a pound of cotton and the return the farmer got for his labor.

Labor Efficiency

Using labor to the best advantage is one of the most important problems with which farm operators deal. Labor requirements are much greater for some enterprises than for others, and at the same time, the demand on all farms for labor is highly seasonal, particularly for crops. Labor requirements for crops constitute the largest cost item in their production. For cotton, this cost amounts to 60.5 percent of the total expenses of growing the crop. Labor requirements for corn, hay, and other crops were somewhat less, but still were the highest single cost item.

Work units per man available on farms. The amount of labor accomplished per man varied from farm to farm, and as the available man equivalent per farm increased, the acres of cropland per farm increased. Farms with an average of 38 acres of cropland had an average of 1.63 man equivalent of labor available. (Table 3).

Since the amount of work accomplished per man available for work on the farm decreased as the size of business (measured by crop acres) increased, farmers operating large acreages should give more attention to using more efficiently the labor they have available under their management. It will be noticed that the acres of cropland per man did not vary much whether on a small farm or a large farm, yet the cost to produce an acre of cotton, or a pound of cotton, was greater as the size of farm business increased, and as the labor performed per man available decreased. The fact that larger farms had the most tenants, and since it was on these farms that labor was used less efficiently, this would tend to explain the unfavorable relationship of cropland per man and the greater cost of producing cotton on the larger farms.

Man-hours per acre of cotton. The labor used per acre of cotton varied very much also. See table 4. Seven farms averaged only 77 man-hours per acre, while a like number of farms averaged 168

Table 3. Relation of man work units accomplished per man available[1] to various factors on 40 farms in Northeast Mississippi, 1944.

Units worked per man available	Number farms	Average units worked per man available	Man equivalent	Acres cropland per farm	Acres cropland per man equivalent	Cost per acre of cotton	Total cost per lb. of lint	Man labor cost per pound of lint
						dollars	cents	cents
Less than 100	9	73	7.75	150	19.3	96.00	15.23	9.3
100 - 149	12	124	3.37	60	17.8	90.00	13.90	7.6
150 - 199	6	170	2.95	54	18.3	64.00	12.65	6.5
200 - 249	6	220	2.34	54	23.1	56.00	9.54	4.3
250 and over	7	310	1.63	38	23.3	48.00	11.43	5.2

[1] Man work units accomplished per man available was determined by dividing the total hours of productive work accomplished per farm by the man equivalent of labor found on the farm. The operator and man cropper tenants were considered as one man each available for 12 months of work. Family labor of the operator and family labor of the man cropper were converted to the equivalent of man labor.

Table 4. Man hours per acre of cotton related to various factors on 32 farms in Northeast Mississippi, 1944.

Man hours per acre	Number farms	Average man hours per acre	Pounds of lint per acre	Cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
		No.	lbs.	dol.	cents	dol.	cents
Less than 100	7	77	286	$57.00	16.5	$15.00	55
100 - 149	17	120	527	86.00	12.7	47.00	72
150 - 199	7	168	532	84.00	12.1	49.00	61
200 +	1	218	573	91.00	13.5	52.00	45
Total	32	126	477	79.00	13.4	—	—

hours. As the man-hours per acre increased, the pounds of cotton produced per acre increased, which was unlike the relationship of labor expended per cow and the milk produced per cow. However, as the pounds of cotton per acre and labor per acre increased, the cost to produce an acre of cotton increased. Unlike the application of labor to cows, as labor on cotton per acre increased, the cost to produce 1 pound of lint decreased and the labor return per hour increased up to 150 hours per acre and then decreased. Consequently, a farmer should be very careful about increasing the hours of labor used per cow and the labor used per acre of cotton above 150 hours under conditions similar to those on the 40 farms in Northeast Mississippi. The part of his total time as operator of the farm that should be devoted to the entire dairy enterprise is another problem and should be considered in the organization of the entire farm business.

Rates of Production

Pounds of cotton per acre. The production of lint cotton per acre ranged from 196 pounds to 837 when considering all farms. Seventy-five percent of all farms growing cotton had an average yield above 400 pounds per acre and 44 percent of the farms producing cotton had a yield above 500 pounds. See table 5.

As production per acre increased, man hours and total cost per acre increased. Likewise, profit per acre and labor return per hour increased. The farmers who produced above 700 pounds per acre received nearly one dollar per hour for their labor used on cotton.

Types of Farming

The yield of cotton per acre varied considerably on the 32 farms producing it. Table 6 shows this variation by types of farming. Cotton-dairy farms grew four times the acreage of cotton as was grown on dairy-cotton farms and a little more than three times the amount grown on dairy & cotton farms. The yield per acre was slightly more than a bale per acre on both cotton-dairy and dairy & cotton farms, whereas the yield was only 2/3-bale per acre on dairy-cotton farms.

The cost of producing a pound of cotton varied little between types of farms,

Table 5. **Pounds of lint per acre related to various factors on 38 farms in Northeast Mississippi, 1944.**

Pounds of lint per acre	Number farms	Average pounds per acre	Man hours per acre	Total cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
		lbs.	no.	dollars	cents	dollars	cents
Below 300	5	242	76	47	16.0	15	48
300 - 399	3	332	96	67	16.7	15	53
400 - 499	10	436	137	72	12.6	37	62
500 - 599	7	573	139	92	12.7	51	76
600 - 699	5	616	138	99	12.3	58	87
700 +	2	798	161	114	10.9	83	93

Table 6. **Types of farming related to various factors in producing cotton on 32 farms in Northeast Mississippi, 1944.**

Type of farming	Acres per farm	Yield 500 lb. bales	Cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
			dollars	cents	dollars	cents
Dairy-cotton	9.1	6.1	57	13.3	27	49
Cotton-dairy	39.9	40.3	86	13.5	38	61
Dairy & cotton	12.1	12.6	84	12.4	48	81
All types	21.8	21.3	83	13.3	39	63

Table 7. Relation of soil fertility to the cost of producing cotton and income on 32 farms in Northeast Mississippi, 1944.

Soil fertility	Number farms	Number of farms in Black Prairie	N. E. High-land	Pon-totoc Ridge	Cost to produce one pound of lint	Return per hour of labor	Labor income per farm	Production per acre
					cents	cents	dollars	lbs.
High	13	11	1	1	12.58	70	1,712	508
Medium	5	3	2	0	11.97	63	1,970	436
Low	14	4	3	7	14.67	68	1,038	462

but varied considerably between individual farms. The cost per pound on dairy-cotton and cotton-dairy farms was 13.3 and 13.5 cents, respectively.

The cost to produce a pound of cotton on dairy & cotton farms was 12.4 cents, or 1 cent less than for the other farm types. The range in cost to produce a pound of cotton on the 32 farms was from 6.67 cents to 21.16 cents. Seventy-five percent of the farms produced cotton at a cost range from 10 to 16 cents per pound, with an average cost of 13.3 cents for all farms.

Labor returns per hour spent on cotton averaged 63 cents for the 32 farms. Low yields per acre undoubtedly account for the low labor return on dairy-cotton farms. On the other hand, yields were approximately the same for cotton-dairy and dairy & cotton farms. Yet, the return per hour of labor on dairy & cotton farms was 33 percent higher than on dairy-cotton farms. This difference was due largely to the fact that the cotton-dairy farms used 31 hours more labor per acre, or 26 percent more than was used by dairy & cotton farms.

Soil Fertility

Detail soil maps for each of the 40 farms in this study were furnished by the Soil Conservation Service of Mississippi and the Bureau of Plant Industry. These maps were used to study in detail soil types on each farm. A staff member of the Experiment Station Soils department assisted in this work by making a visit to each farm to study the types of soils, placing special emphasis on the fertility of the soils and the adaptability of crops to the soils on which they were being grown. Farms were then classed as high, medium, and low in fertility, for the purpose of finding relationships between farms of different fertility levels and the costs of production and income.

Soil fertility related to costs and returns. Half of the farms in the Black Prairie Area were classed high in fertility. One-half the farms in the Northeast Highland Area were low in fertility, and 85 percent of the farms in the Pontotoc Ridge Area also were classed low in fertility.

For the areas as a whole, the cost to produce one pound of cotton increased as soil fertility decreased. See table 7. The difference in costs between farms of high fertility and low fertility was approximately 2 cents per pound. With a market price of 20 cents for cotton, a spread of 2 cents per pound amounts to $10 per bale. Interest at 5 percent on an investment of $200 amounts to $10. Consequently, it would appear that a farmer can afford to pay considerably more for land of high fertility when purchasing land for the purpose of growing cotton. The rate of cotton production was greater on farms of high soil fertility, as would be expected. This, of course, was a major factor influencing the smaller cost of producing a pound of cotton on these farms.

Soil-Crop Adaptation

Growing a crop on the type of soil to

Table 8. **Soil crop adaptation related to various factors on 40 farms in Northeast Mississippi, 1944.**

Soil crop adaptation	Number farms	Lint cotton		Corn		Return per hour labor on cotton	Labor income
		Per acre	Cost per pound	Per acre	Cost per bushel		
		lbs.	cents	bu.	cents	cents	dollars
Good	22	517	12.42	26	.94	73	1,709
Fair	14	407	15.05	26	1.10	61	1,076
Poor	4	424	15.17	14	1.41	54	1,033

which it is best adapted usually gives the highest labor returns. Progressive farm operators give much thought to placing crops in their farm layouts so that this relationship exists. Table 8 shows the relationship of the adaptation of crops to soils on the 40 farms in this study. On 22 farms, the adaptation of crops to soils on which they were grown was "good"; on 14 farms, "fair"; and on 4 farms it was "poor." The adaptation of crops to soils on the farms as a whole was used as a basis for the above classification.

The rate of production was highest where soil crop adaptation was good. It cost 12.42 cents to produce a pound of lint cotton where adaptation was good, 15.05 cents where it was fair, and 15.17 cents where adaptation was poor.

The cost to produce a bushel of corn was 94 cents where soil crop adaptation was good, $1.10 where it was fair, and $1.41 where soil crop adaptation was poor. The cost of producing cotton per pound was 23 percent greater on farms with poor soil crop adaptation than on farms when the soil crop adaptation was good.

It cost 50 percent more to produce corn on farms where the soil crop adaptation was poor than where the soil crop adaptation was good. Also, it will be observed that labor return per hour spent on cotton was 73 cents where soil crop adaptation was good, 61 cents where it was fair, and 54 cents on farms where it was poor. Labor income was highest on farms where soil crop adaptation was good and lowest on farms with poor soil crop adaptation.

Recommendations

In summary, the findings of this study appear to suggest the following recommendations:

Grow cotton on soils of high fertility. The cost to produce cotton on farms of high soil fertility was 12.58 cents per pound, whereas the cost was 14.67 cents on farms of low soil fertility, or a cost spread of nearly 2 cents. This spread of cost between high and low fertility farms was nearly 4 cents per pound in the Black Prairie Area. On land that produced between 700 and 800 pounds of lint per acre, the profit on each acre was $83. On land that produced between 200 and 300 pounds of lint, the profit per acre was only $15.

Use labor more efficiently. The average cost to grow a pound of lint was 13.28 cents. Labor amounted to 8.04 cents of this cost, or 60.5 percent of the total cost to produce a pound of lint cotton. On farms where the average labor performed per man available was less than 100 days during the year, the man labor cost to produce one pound of lint cotton was 9.3 cents. Where the days of labor per man were 250 and above, the man labor cost was 5.2 cents per pound.

Grow crops on soils to which they are best adapted. On farms where soil-crop adaptation was good, the cost to produce a pound of cotton was 12.42 cents, and the cost to produce a bushel of corn was 94 cents. Where soil-crop adaptation was poor, the cost was 15.17 cents per pound for cotton and $1.41 per bushel for corn.

Reduce costs by increasing rates of production. Farms that produced cotton at the lowest cost had the highest yields, or 1.14 five-hundred-pound bales per acre, and farms producing cotton at the highest cost had the lowest yields or 0.78 five-hundred-pound bale per acre.

Large farms should use available labor more fully. Days of work (10-hour days) per man on farms with more than three man-equivalents available, averaged less than 125 for the year. Days of work per man on farms with 1.6 man-equivalents available averaged 310 for the year.

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Farmers Keeping Records in 1944:

Alcorn County

Frank Conn
Austin O. Miller
Bill Parke

Chickasaw County

David F. Arndt
I. W. Baird
J. C. Baird
Howard Brand
E. F. Brent
E. L. Gann
P. A. Morgan
R. T. Turner

Lee County

G. C. Evans
Elmer Hurt
J. I. Maxey
T. L. Roper
N. B. Scott

Noxubee County

Henry Boykin
Eugene Butler
C. T. Davis
G. D. Douglass, Jr.
Spence S. Guy
Johnny Heard
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Farm Management and Costs of Production on 40 Farms in Northeast Mississippi

By W. J. EDENS[1]

This bulletin reports a study, by the cost account method, of 40 dairy and cotton farms in Northeast Mississippi for the calendar year 1944. The purpose of the study was to determine farm costs and farm management practices in their relation to production problems and income, especially on farms producing milk for sale, and with possible recommendations for adjustments. Attention in particular is given to the costs of producing milk and cotton in their relationship to types of farm organization, and profits derived from these major enterprises as well as from minor enterprises and the farm business as a whole. It is hoped that the results of this study will stimulate farmers of the area to give more thought to the organization of their farms and to utilize more efficiently the land, capital, and labor under their management, and will serve as a means of facilitating the agricultural extension program of this State.

Most of the farms in Northeast Mississippi produce cotton and a large number keep milk cows. Cotton has been the principal income crop since the area was first settled. Since the turn of the century, it has been demonstrated that a single row-crop enterprise as the main source of income involves considerable risk and does not give a return to the farm business as a whole comparable to that which is realized when income enterprises are more diversified. Consequently, farmers and various agricultural agencies have been endeavoring to find the best means and methods to be used in providing the most profitable combination of enterprises for farms in each of the naturally defined areas of the State.

Emphasis has been placed on more livestock production as well as improved practices in growing crops. For the past three decades, much attention has been given to dairying as a supplement to cotton production. Agricultural and various business and civic agencies have encouraged the establishment of milk processing plants such as cheese factories, creameries, and condenseries in many communities of the State with most of the larger plants located in Northeast Mississippi. Fifty-seven of these plants have been established since 1912. At present, 31 are in operation with most of the fatalities having occurred among creameries. Nineteen of the 31 plants now in operation are located in the 11 counties constituting the Northeast Mississippi Milkshed Area.[1]

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[1] **Professor of Agricultural Economics, Mississippi State College.**

With the coming of these plants, the dairy cow population in the respective communities, or patronage areas, increased considerably. Many thought that this step in farm enterprise diversification would solve the one-crop system of farming. It has helped; but the problems have arisen such as low production per cow, unprofitable methods of feeding, high-cost transportation, low production during winter months making it difficult for milk plants to operate efficiently during that period, and dairy cattle diseases, and parasites. While some farmers appeared to be profiting by adding dairying to their business, others appeared to be deriving little benefits from milking cows along with the production of cotton.

Since so many factors—size, rates of production, combination of enterprises, use of labor, farm practices—are responsible for determining the profit made by the farm business, it was thought that if a study were made of representative farms where milk was produced and sold to milk plants so that detailed attention could be given to those factors largely determining profits, much benefit might be derived for both farmers and milk plants.

Location of Farms Studied

Farms selected to cooperate in this study were located in Alcorn, Prentiss, Lee, Chickasaw, and Noxubee Counties, all of which are found in the three major soil areas of Northeast Mississippi, namely, Northeast Highlands, Northeast Prairie, and the Pontotoc Ridge. (See figure 1.) Though the Northeast Prairie Area separates the Northeast Highlands and Pontotoc Ridge Areas, the soils of all three areas are rather distinct.

The Northeast Highland Soil Area developed mostly from coastal plain deposits of sand, clay, and gravel. They are red or yellow wherever the drainage is good, and are generally quite sandy in texture. The rugged topography of parts of the area and poor solid management practices have contributed to severe erosion of the soil on many farms. The commonly occurring soils of the Northeast Highlands are Ruston, Savannah, Cuthbert, Paden, and Ocklocknee. The principal crops grown in this area are cotton, corn, oats, lespedeza, cowpeas, and soybeans. In addition to the field crops, pine timber affords a cash income in several locations.

The soils of the Northeast Prairie are derived from soft, chalky limestone and clays which are coastal plain deposits. Because of the nature of the parent material, the soils possess texture of the clay and heavy clay classes. The topography is gently rolling and sheet erosion has wrought great damage to much farm land. The soils are easily recognized by the dark and red colors, and vegetation of grass and post oak. The dark soils are Houston, Sumpter, and Trinity,

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[1] Development of the Dairy Industry in Mississippi, by D. W. Parvin. Mississippi Agricultural Experiment Station Bulletin 422, July, 1945.

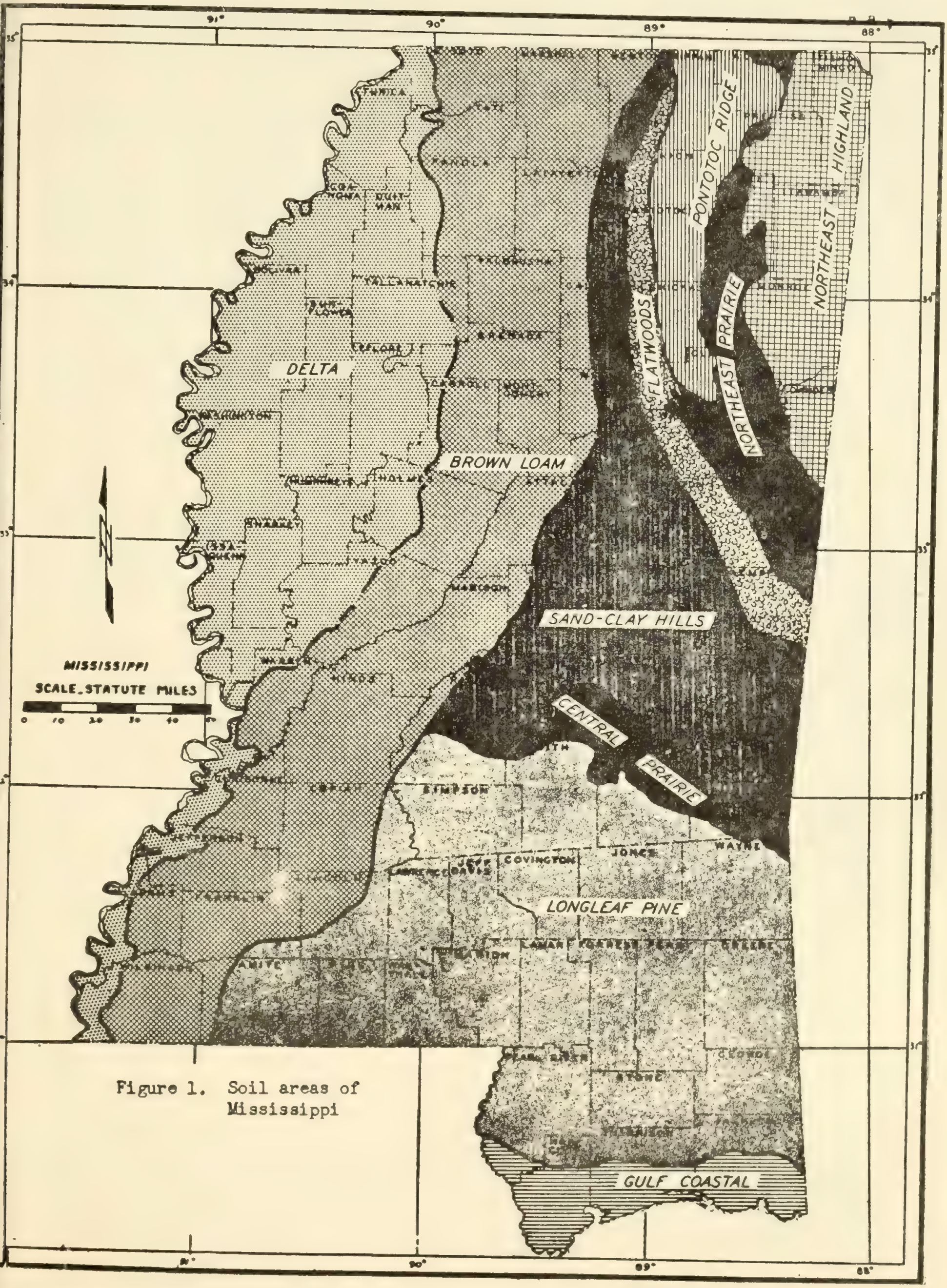
DELTA
BROWN LOAM
FLATWOODS
PONTOTOC RIDGE
NORTHEAST PRAIRIE
NORTHEAST HIGHLAND
SAND-CLAY HILLS
CENTRAL PRAIRIE
LONGLEAF PINE
GULF COASTAL
MISSISSIPPI
SCALE_STATUTE MILES
0 10 20 30 40 50
91°
90°
89°
88°
35°
34°
33°
32°
31°

Figure 1. Soil areas of
Mississippi

commonly called "Black Prairie", and the red soils are Oktibbeha and Montrose, commonly called "Post Oak Prairie." The crops grown are cotton, corn, oats and silage crops, and much livestock is fed. Johnson grass is well adapted to this area and is used for hay along with soybeans. Dallis grass and white and hop clovers, make excellent pastures in this area and contribute much to the production of livestock.

Soils of the Pontotoc Ridge Area have developed from marine deposits of sands and clays that are reddish in color, and naturally the soils are predominantly reddish in color. The texture varies from a sandy loam to clay. The topography is rolling to rough and rugged. Thus, the soils have suffered severe damage from accelerated erosion where protective measures have not been applied. The main soils are Greenville, Orangeburg, and Ruston, on uplands, and Hannahatchie and Ocklocknee. The principal crops are corn and cotton for row crops; lespedeza, soybeans, and cowpeas for hay. Pine timber also contributes to the income of the farmers.[1]

Method of Selecting Farms

Farms selected for this study were suggested by county agricultural agents, milk plant managers and their field men, county representatives of the Agricultural Adjustment Agency, and local representatives of the Soil Conservation Service. These agricultural leaders were requested by personal interview to suggest farmers who, they thought, were progressive in their farm operations, would be interested in making a study of their farm business, and would be willing to keep the necessary records.

The enterprise organization of each farm was studied by means of the 1944 farm plan sheets made available by the several county AAA officers. Farms were then divided into three groups determined by the emphasis placed on the production of milk and cotton, and farm types were so designated. Farms with a large number of cows compared with the number of acres in cotton comprised one group, or *dairy-cotton* farms. A few farms in this group did not grow cotton after having planned to do so. Where the number of acres of cotton was large in proportion to the number of cows, the farm type was designated *cotton-dairy.* The farms having about the same number of cows as acres of cotton constituted the third type, or *dairy & cotton.* Of the 40 farms keeping records, 16 were dairy-cotton, 12 cotton-dairy, and 12 dairy & cotton. This manner of grouping was selected in order that comparisons could be made relative to cost factors and income for the various farm enterprises under different organizational conditions.

Operators of the farms thus selected were interviewed on their farms where consent was obtained to keep the necessary rcords. The supervision of the keeping of the records was done by a member of the Experiment Station staff, and each farm was visited once every 4 weeks.

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[1] The description of these three soil areas was taken largely from their description as set forth by the Mississippi State Department of Agriculture, 1942.

Description of Farms Studied

Land Utilization

The average amount of land per farm for the 40 farms was 170 acres. Table 1 shows how the total land for all farms as a whole and by types of farms was used. Cropland accounted for 75 acres per farm, or 44 percent of total land. Open, tillable pasture land amounted to 43 acres per farm, representing 25 percent of all land; and open non-tillable pasture land amounted to 21 acres, or 12 percent. Thus, 81 percent of all land was open land. Woods pastured accounted for 8 percent of the land per farm; woods not pastured, 5 percent; and the other land used for miscellaneous purposes, 5 percent. It will be noted that pasture land of all kinds amounted to 88 acres, or slightly more than one-half of the total average acreage per farm.

On farms where cotton was the major enterprise, 55 percent of the land was cropland. Where dairy cows were the major enterprise, 30 percent of the land was cropland; and where the two enterprises ranked about the same, 42 percent of the land was devoted to crops. It will be noted that where major emphasis was placed on dairy cows, slightly more than half of the total land was devoted to open pasture. Where cotton received major emphasis, only 30 percent of the farm acreage was used for open pasture land.

Table 1. Use of land on 40 farms and on different types of farms in Northeast Mississippi, 1944

Land use	Average number of acres							
	40 farms		Dairy-cotton		Cotton-dairy		Dairy & cotton	
	Per farm	Pct. of total	Per farm	Pct. of total	Per farm	Pct. of total	Per farm	Pct. of total
Cropland	75	44.1	44	29.9	140	55.3	50	41.9
Open pasture, tillable	43	25.3	48	33.0	47	18.7	33	27.4
Open pasture, not tillable	21	12.4	27	18.4	28	11.0	8	6.5
Woods pastured	14	8.2	18	12.5	11	4.3	11	9.2
Woods not pastured	9	5.3	5	3.3	14	5.4	12	10.1
Other land	8	4.7	4	2.9	13	5.3	6	4.9
Total	170	100.0	146	100.0	253	100.0	120	100.0

Crop Acres

On the average, more acreas of land were devoted to corn than to cotton. Corn and cotton acreages were about the same on cotton-dairy farms. Hay constituted the largest acreage of any crop. Table 2 shows the relative importance of crops grown. Other than cotton, cash crops were relatively unimportant on most farms. Two farms produced hay for sale and one raised watermelons and cantaloupes for the market. It will be noted that less than one-half acre per farm was used for growing silage crops. Only six farmers grew silage. These six farms grew an average of 2 acres per farm.

Table 2. Crop acres on 40 farms and on different types of farms in Northeast Mississippi, 1944

Crop	40 farms		Dairy-cotton		Cotton-dairy		Dairy & cotton		Number of farms growing crops
	Acres per farm	Pct. of total	Acres per farm	Pct. of total	Acres per farm	Pct. of total	Acres per farm	Pct. of total	
Cotton	17.2	22.8	4.4	10.0	39.9	28.2	12.1	22.6	32
Corn	21.8	28.9	12.2	29.0	39.4	27.8	16.9	31.5	37
Oats	6.8	9.0	5.5	13.1	8.0	5.6	7.3	13.6	14
Soybeans (seed)	.2	.3	----	----	----	----	.5	.9	1
Lespedeza (seed)	.1	.1	----	----	----	----	.3	.6	1
Johnson grass hay	10.7	14.7	5.6	13.3	28.2	19.9	----	----	8
Lespedeza hay	2.4	3.2	3.8	9.2	2.1	1.5	.9	1.7	11
Soybean hay	8.3	11.0	5.8	13.8	15.7	11.1	4.5	8.4	21
Other hay	5.2	6.7	3.8	9.2	4.6	3.2	7.5	14.0	18
Total hay	26.6	35.3	19.0	45.1	50.6	35.7	12.9	24.1	----
Sorghum, silage	.4	.5	.5	1.2	.2	.1	.6	1.1	6
Sorghum, syrup	.1	.1	----	----	----	----	.3	.6	3
Truck and garden	.7	1.0	.4	1.0	1.5	1.1	.5	.9	40
Other crops	1.5	2.0	.1	.2	2.0	1.4	2.2	4.1	----
Crop acres[1]	75.4	100.0	42.1	100.0	141.6	100.0	53.6	100.0	----
Double crop acres[2]	3.0	----	2.4	----	6.7	----	5.1	----	----
Land cropped	72.4	----	39.7	----	134.9	----	48.5	----	----
Idle	2.7	----	4.3	----	5.1	----	1.6	----	----
Total cropland	75.1	----	44.0	----	140.0	----	50.1	----	----

1. Crop acres—Total acres of crops, includes double cropping.
2. Double-cropping acres are included in the above crop acreages.

On farms where dairying was the major enterprise, 74 percent of the acres cropped was devoted to feed crops; on cotton-dairy farms, 69 percent; and on dairy & cotton farms, 69 percent. Acres of oats per farm averaged 6.8. However, only 14 of the 40 farms actually growing oats had an average of 19.4 acres per farm.

Hay was an important crop on most of the farms. Johnson grass predominated in the Northeast Prairie Area, but in the Pontotoc Ridge and Northeast Highland Areas, soybean acreage for hay was greatest. Lespedeza was next in importance. A considerable number of farms interplanted corn with soybeans and harvested the plants for hay or stocked them down. Most of the farmers growing soybean hay, ground it before feeding it to dairy cows and other livestock.

Classes of Livestock

Dairy cows were the most numerous livestock on the average farm. Table 3 shows the importance of all classes of livestock. The average number of dairy cows per farm was 14, with a total value of $981 per farm, or an average value of $69 per cow. Milk cows constituted 47.3 percent of the total farm investment in livestock. The range in number of dairy cows for all farms was from 4 to 40. Only two farms milked less than 6 cows; 4 less than 7 cows; and 10 less than 10 cows. Nine farms milked 20 or more cows. Nineteen herds averaged 4,000 pounds per cow or more, and 8 had an average production of more than 5,000 pounds of milk per year. The range in the amount of milk produced per cow per year was from 2,200 pounds to 5,800 pounds with 4 herds producing less than 3,000 pounds per cow.

Table 3. Classes of livestock and their values on 40 farms in Northeast Mississippi, 1944

Class	Number per farm	Value per farm	Percent of total
Dairy cows	14.2[1]	$981	47.3
Other cattle	10.9	399	19.2
Hogs	9.1	106	5.1
Hens	80.0	84	4.1
Workstock	4.4	497	23.9
Other[2]	2.4	9	.4
Total	-------	2076	100.0

1. Average for 5 inventories during the year.
2. Average for 39 farms.

Other cattle[1] amounted to 11 head per farm and 19.2 percent of the total average investment in livestock. Other cattle consisted of bred heifers, steers, bulls, and calves. Hogs were of minor importance on more than 75 percent of all farms. A few farmers raised hogs for the market while all others grew hogs primarily for home consumption, selling the small surplus produced.

Most poultry flocks were for home use. However, a majority of the farms sold some eggs and a few sold young birds. Nine farms had more than 100 hens, and 4 had more than 150 hens.

Table 3 shows the importance of workstock. Next to milk cows, the largest investment in livestock was in the enterprise used for farm power.

Farm Investment

The investment per farm amounted to $10,743. The distribution of this investment is shown in table 4. Cotton-dairy farms had the largest investment, as might be expected on account of larger cropland requirements. Dairy-cotton and dairy & cotton farms were more nearly equal in real estate investment and total investment.

Table 4. Average farm capital per farm for 40 farms and by types of farms in Northeast Mississippi, 1944

Item	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton	Per acre 40 farms
	dollars	dollars	dollars	dollars	dollars
Land	4,073	2,422	7,712	2,635	23.96
Buildings	2,257	2,116	3,022	1,680	13.28
Fences	136	153	142	107	.80
Total real estate	6,466	4,691	10,876	4,422	38.04
Livestock	2,076	2,336	2,025	1,778	12.21
Equipment	1,039	986	1,436	713	6.11
Feeds	1,029	849	1,429	868	6.05
Miscellaneous supplies	133	87	236	95	.79
Total	10,743	8,949	16,002	7,876	63.20

Table 5 shows the relative distribution of farm investment for all farms as well as for types of farms. The average investment in real estate for the 40 farms was 60.2 percent. On cotton-dairy farms the investment in real estate was 68 percent, while dairy-cotton and dairy & cotton farms had a real estate investment of 52.5 and 56.1 percent, respectively. Investment in livestock was lowest on cotton-dairy farms. The relative investments in feeds and equipment were about the same.

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[1] All cattle other than milk cows. Only one farm had beef cattle.

On farms where dairy cows were the major enterprise and on farms where cows and cotton received about the same emphasis, the total investment per farm was approximately one-half of the investment on farms where cotton was the major enterprise. The percent return on investment for cotton-dairy farms was 10.4, on dairy-cotton farms 14.4 percent, and 16.2 percent on dairy & cotton farms.

Table 5. Distribution of investment on 40 farms and by types of farming in Northeast Mississippi, 1944

Item	Percent of investment			
	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton
Land	37.9	27.1	48.2	33.5
Buildings	21.0	23.7	18.9	21.3
Fences	1.3	1.7	.9	1.3
Total real estate	60.2	52.5	68.0	56.1
Livestock	19.3	26.1	12.7	22.6
Equipment	9.7	11.0	9.0	9.1
Feeds	9.6	9.5	8.9	11.0
Miscellaneous supplies	1.2	.9	1.4	1.2
Total	100.0	100.0	100.0	100.0

Farm Receipts and Expenses

Farm receipts are the total income from farm sources. They include money received or due from the sale of the current year's crops, sale of livestock and livestock products, sale of equipment and supplies, and any increase in the inventory value of the farm property. Farm receipts for the 40 farms averaged $5,930. (See table 6.)

Table 6. Financial summary for 40 farms and by types of farms in Northeast Mississippi, 1944

Item	40 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton
	dollars	dollars	dollars	dollars
1. Farm investment	10,743	8,949	16,002	7,876
2. Farm receipts	5,930	5,145	8,334	4,573
3. Farm expenses	3,973	3,298	6,106	2,740
4. Farm income (2 minus 3)	1,957	1,847	2,228	1,833
5. Interest on investment @ 5%	537	447	802	394
6. Labor income (4 minus 5)	1,420	1,400	1,426	1,439
7. Farm privileges	590	623	576	560
8. Labor earnings (6 plus 7)	2,010	2,023	2,002	1,999
9. Value operator's time*	557	557	557	557
10. Return on investment	1,400	1,290	1,671	1,276
11. Percent return on investment	13.0	14.4	10.4	16.2

*The operator's labor was valued at current wages for a hired man without meals and lodging for 12 months. Unpaid family labor was valued at the same rate.

Farm expenses represent the cost of operating the farm business, except for interest on investment and value of the operator's time. Farm expenses include all cash expenses for labor, feed, supplies, taxes, etc.; the value of unpaid family labor other than the operator's; the value of board furnished hired help; the cost of livestock and equipment purchased; and any decrease in the inventory value of farm property. Farm expenses, or farm business expenses, do not include family living expenses. The average farm expenses for 40 farms was $3,973.

Farm Returns

Farm income and other measures of return to the farm operator are also shown in table 6. Farm income, which is farm receipts less farm expenses, amounted to $1,957 for the 40 farms as a whole. Deducting from farm income the amount of interest at 5 percent on the average investment, gives a labor income of $1,420. Labor earnings are found by combining labor income and farm privileges.[1] This amounted to $2,010 per farm.

The operator's time was valued at current wages paid hired labor without board and lodging in Northeast Mississippi, as reported by the Bureau of Agricultural Economics. All operators were credited with 12 months of labor except one who spent some of his time off the farm.

Return on the average farm investment was $1,400 or 13 percent. The operator's time may have been undervalued. If that were true, the percentage return on investment would be less in proportion to the increase of the value of the operator's time.

Farm receipts and expenses for the different types of farms varied directly with the size of the investment. However, it will be noticed that labor income did not vary much from one type to another. Causes for these differences and similarities will be discussed in following sections of this study.

Methods Used in Determining the Costs of Producing Milk

All farm costs were determined by means of a set of accounts kept by each farmer. Records began with taking an opening inventory, January 1, 1944, and included transactions during the year pertaining to the farm business. The closing inventory was taken December 31. Daily labor records, feeding records, production records. cash records, and other records were kept. Methods used in keeping these records follow.

Feed. Feeds fed to dairy cows were both purchased and produced on the farm. Most concentrates were purchased, whereas, practically all roughages were grown by the farmer. Purchased feeds were charged at market price, and home-grown feeds were charged at farm price. Farm price was market price less the cost of transportation to the market.

The amount of feeds fed was recorded monthly. Once each month—usually the latter part of the month—the farmer determined the pounds of concentrates and roughages fed to his herd for one day, and multiplied these amounts by the number of days in the month.

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[1] **Farm privileges means contributions made by the farm to family living, such as house rent and foods.**

If changes occurred in the kinds of feed fed during the month, or if the number of cows in the herd increased or decreased, this was taken into consideration in order not to overcharge or undercharge the proper amounts. The pasture cost was computed by determining the total pasture cost for all livestock and then allocating the proportionate part to the milk cows. This cost was estimated by the farmer.

Pasture. Pasture costs included interest on investment in pasture land, taxes, man and horse labor used on the pastures, and the cost of pasture fences. Crops grazed, such as oats, were charged at the rate of $3.00 per month for each milk cow.

Man labor. The charge for man labor was the average cost per hour for all labor on the farm except that of cotton croppers. Cropper cotton labor was charged directly to the cotton enterprise. Thus, the cost per man hour for all enterprises other than cotton was the average cost per hour on the farm for all labor except labor spent on cotton by cropper tenants. In addition to cash wages, labor costs included the value of the operator's time, unpaid family labor, and the use of tenant houses. The average rate per hour was determined by dividing the total labor costs, less the value of the cropper's share of the cotton and seed, by the total hours of work less the hours spent on cotton by croppers. The total cost of man labor for milk cows was completed by multiplying the average farm labor hour rate by the total hours spent on milk cows. Hours of labor spent on cows included the time spent in milking, feeding, cleaning milk house, and washing utensils.

Buildings. The cows were charged with their proportionate part of the cost of maintaining building for the year. This cost included repairs, depreciation, interest on investment, insurance and taxes. The total expense for any building used entirely for milk cows was charged to the herd.

Dairy equipment. The investment in equipment for most herds was small. This cost included depreciation, repairs, and interest on investment.

Depreciation on cows. Depreciation on milk cows was determinated by using the following formula: depreciation equals (value of cows at the beginning of year plus value of heifers freshening plus value of cows purchased) minus (value of cows at the end of year plus value of cows sold and any that died). This charge for depreciation accounts for both depreciation in the case of young cows and depreciation for old cows.

Interest. Milk cows were charged with interest at the rate of 5 percent on the average of the beginning and ending inventories values.

Milk hauling. Practically all farmers hired the hauling of their milk to the milk plants. Where the farmer hauled his own milk, man hours and the proportionate part of the truck, or car, costs used for handling the milk were estimated by the farmer.

Miscellaneous costs. Miscellaneous costs included such items as the proportionate part of truck or auto expense, electricity, sprays, disinfectants, veterinary services, medicines, etc.

Costs and Returns for Milk Production

Milk was produced for sale on all farms. About 12 percent of all milk produced was used on the farm. Practically all of the remaining 88 percent was sold to cheese plants and condenseries. A few farmers sold their milk to wholesale distributors.

The average number of milk cows per farm was 14. (See table 7.) This average number of milk cows per herd was computed from the beginning and ending inventories and five other inventories during the year. Milk produced per farm amounted to 55,991 pounds, or 3,931 pounds per cow. The family used 3,861 pounds of milk, and the average farm fed 2,729 pounds of milk to calves.

A study of table 7 shows the amount of costs for the various items entering into the total costs for the average dairy herd as well as per cow and per 100 pounds of milk. This table also shows herd credits, such as manure and calves produced, and the returns from milk produced. Detail consideration is given to these items in the sections that follow.

Table 7. Production, disposal and costs of and returns for milk on 40 farms in Northeast Mississippi, 1944

Item	Average per herd	Average per cow		Average 100 lbs. of milk	Proportion of total
		Amount	Value		
Costs	dollars	hours or pounds	dollars	dollars	percent
Feeds:					
Concentrates	608.37	1,516	42.71	1.09	32.7
Roughages	371.72	2,624	26.09	.66	20.0
Pasture	129.12	....	9.06	.23	6.9
Total feed	1,109.21	....	77.86	1.98	59.6
Man labor	507.35	145	35.62	.90	27.3
Horse labor	.15	....	.01	.00	.0
Buildings	34.47	....	2.42	.06	1.9
Equipment	18.05	....	1.27	.03	1.0
Depreciation on cows	82.71	....	5.81	.15	4.4
Interest	48.75	....	3.42	.09	2.6
Miscellaneous	59.83	....	4.20	.11	3.2
Gross farm costs	1,860.52	....	130.61	3.32	100.0
Credits:					
Manure	108.35	....	7.61	.19	.....
Calves	28.82	....	2.02	.05	.....
Total credits	137.17	....	9.63	.24	.....
Net farm costs	1,723.35	....	120.98	3.08	.....
Hauling charges	126.09	....	8.85	.25	.....
Total costs	1,849.44	....	129.83	3.33	.....
Returns					
Milk returns:					
Milk sold	1,987.36	....	139.51	4.02	.....
Milk used on farm	232.27	....	16.31	.....	.....
Total milk returns	2,219.63	....	155.82	.....	.....
Profit	370.19	....	25.99	.69[1]	.....
Labor returns	877.54	....	61.61	1.59[1]	.....

[1]/ Per 100 pounds sold.

Average number cows per herd	14	Milk produced per farm	55,991 lbs.
Average produced per cow	3,931	Milk sold per farm	49,401 lbs.
Pounds sold per cow	3,468	Personal use per farm	3,861 lbs.
		To calves per farm	2,729 lbs.

Feed Costs

Feed was the largest item of cost in the production of milk. (See table 7.) The feed cost per herd for one year on all farms averaged $1,109. Of this, concentrates amounted to $608; roughage, $372; and pasture, $129. This total feed cost amounted to 59.6 percent of total milk production costs. On a per cow basis, this feed cost per year was $78, and the feed cost to produce 100 pounds of milk was $1.98.

The amount of feed per cow varied considerably, and much of this variation was due to whether there was available suitable land for hay and pasture production in the three soils areas in Northeast Mississippi—Black Prairie, Northeast Highland, and Pontotoc Ridge. The five farms feeding the least concentrates averaged 642 pounds per cow. The five farms feeding the most concentrates averaged 2,898 pounds per cow. The five farms feeding the least roughage averaged 969 pounds per cow, and the five farms feeding the most roughage averaged 5,157 pounds per cow. The capacity of milk cows, the knowledge of farmers relative to desirable feeding standards, and high feed costs were other factors contributing to the wide variation in the amounts of feed fed on various farms.

Tables 8 and 9 show the relationships of concentrates and roughages fed per cow to milk produced per cow, and the cost to produce 100 pounds of milk. When concentrates fed per cow were increased, milk produced per cow increased. On the other hand, when roughage per cow was increased, there was a slight decrease in the amount of milk produced. The cost to produce milk increased as the amount of both concentrates and roughage fed per cow was increased.

Table 8. Concentrates fed per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Concentrates per cow, pounds	Number of farms	Average concentrates per cow	Milk per cow	Cost per 100 lbs. milk	Roughage per cow
		pounds	pounds	dollars	pounds
Less than 1,500	23	851	3,774	3.08	2,518
1,500-3,000	15	2,020	4,347	3.78	3,112
3,000 and over	2	3,297	5,150	3.25	1,609

Table 9. Roughage fed per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Roughage per cow, pounds	Number of farms	Average roughage per cow	Milk per cow	Cost per 100 lbs. milk	Concentrates per cow
Less than 1,500	7	1,085	4,186	2.58	1,609
1,500-3,000	20	2,280	4,085	3.22	1,347
3,000 and over	13	4.202	3,946	3.95	1,404

Feed costs varied considerably according to type of farming. Table 10 shows the cost items for the production of milk on all farms, dairy-cotton farms, cotton-dairy farms, and dairy & cotton farms, as well as for the five lowest cost[1] farms and the five highest cost[1] farms.

Concentrates fed during the year to cows on dairy-cotton farms amounted to $50.51 per cow, which was the highest value of the three types of farms. This could be expected on farms where farmers placed the most emphasis on the dairy enterprise. However, these same farms had the least roughage cost of $23.70 per cow, compared with $32.14 for cotton-dairy farms, and $24.66 for dairy & cotton farms. Total feed costs were the greatest on dairy-cotton farms, next on cotton-dairy, and least on dairy & cotton farms.

The five farms producing milk at lowest cost, fed $43.10 worth of feed per cow, and the five farms producing milk at the highest cost fed $96.34 worth of feed. Since cows on high cost farms produced only 3,230 pounds each, this would indicate that these farm operators were attempting to get high production out of cows of low efficiency.

Man Labor Costs

Labor used to produce milk was furnished primarily by members of the operator's family. A few farmers hired some labor for the dairy enterprise, paying cash wages, a part of the milk check, or by allowing the helper so much milk for family use. Farm labor was very scarce in 1944 and, consequently, high priced. Due to this fact, labor costs were relatively higher than other fixed costs as buildings, equipment, depreciation on cows, and interest charges.

The cost of labor per herd was $507 as shown in table 7. The average number of man hours spent on one cow per year was 145, and was valued at $35.62. This amounted to 91 cents per 100 pounds of milk produced. The labor cost range for 100 pounds of milk was from 46 cents to $1.65. The amount of labor used per cow for one year ranged from a low of 96 hours for the 10 lowest farms to a high of 209 hours per cow for the 10 farms requiring the greatest amount of labor. The average cost of labor per hour spent on milk cows on all 40 farms was 24.5 cents. The range for this man-hour costs was from 16.4 cents to 39.5 cents. In producing milk, man labor accounted for 27.3 percent of the gross farm cost to produce 100 pounds of milk. Consequently the efficient use of labor is an important factor in producing milk economically.

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[1] Based on the cost to produce 100 pounds of milk.

Table 10. Production, disposal, costs and returns of milk per cow by types of farms in Northeast Mississippi, 1944

Item	Average 40 farms	Type of farm				Five high cost farms[1]
		Dairy-cotton (16 farms)	Cotton-dairy (12 farms)	Dairy & cotton (12 farms)	Five low cost farms[1]	
No. farms	40	16	12	12	5	5
No. cows per farm	14	19	12	10	11	15
Lbs. milk per farm	3931	3993	3413	4392	4633	3230
Man hours per cow	145	148	158	124	124	179
Costs						
Feeds:						
Concentrates	$42.71	$50.51	$32.65	$36.02	$18.55	$41.39
Roughages	26.09	23.70	32.14	24.66	17.16	42.95
Pasture	9.06	7.62	13.39	7.42	7.39	12.00
Total feed	77.86	81.83	78.18	68.10	43.10	96.34
Man labor	35.62	33.32	41.83	33.77	31.63	42.63
Buildings	2.42	2.12	3.35	2.02	1.47	2.65
Equipment	1.27	1.64	.97	.73	.49	1.45
Depreciation on cows	5.81	2.88	7.64	10.59	8.16	12.51
Interest	3.42	3.45	3.13	3.69	3.00	3.17
Miscellaneous	4.20	3.82	5.03	4.14	1.96	4.88
Horse labor	.01	.02	—	—	—	—
Gross farm costs	130.61	129.08	140.13	123.05	89.81	163.63
Credits:						
Manure	7.61	7.63	7.67	7.46	7.49	7.57
Calves	2.02	1.56	2.52	2.54	2.17	2.47
Total credits	9.63	9.19	10.19	10.00	9.66	10.04
Net farm costs	120.98	119.89	129.94	113.05	80.15	153.59
Hauling charges	8.85	8.98	7.61	10.02	11.61	6.80
Total costs	129.83	128.87	137.55	123.07	91.76	160.39
Returns						
Milk returns:						
Milk sold	$139.51	$151.05	$111.30	$145.30	$144.46	$114.84
Milk used on farm	16.31	13.62	19.03	19.47	24.44	12.87
Total milk returns	155.82	164.67	130.33	164.77	168.90	127.71
Profit	25.99	35.81	—7.22	41.70	77.14	—32.68
Labor returns	61.61	69.12	34.61	75.47	108.77	9.95

1. The cost of producing 100 pounds of milk.

The cost of producing milk on dairy and cotton farms was lowest and profit per cow was highest. Dairy and cotton farms spent less for feeds, less than average for labor, and had the highest production per cow.

Building Costs

Milk cows were charged with building costs on the basis of the proportionate part of the barn used by the cows. This cost amounted to $34.47 per herd for the year, or $2.42 per cow. The building cost per 100 pounds of milk produced was $0.06.

Equipment Costs

Equipment cost per herd amounted to $18.05. The cost per cow for one year was $1.27, and the cost per 100 pounds of milk produced was $0.03.

Depreciation Costs

The depreciation on the average herd of cows was $82.71. This amounted to $5.81 per cow, or 15 cents per 100 pounds of milk produced. This cost accounted for 4.4 percent of the total gross farm cost of producing milk.

Interest Cost

Interest cost at 5 percent on the average investment in the herd amounted to $48.75. This was equivalent to $3.42 per cow and about $0.09 per 100 pounds of milk produced.

Miscellaneous Costs

Miscellaneous costs were $59.83 per herd, or $4.20 per cow. This cost amounted to about $0.10 per 100 pounds of milk produced.

Gross Farm Costs

The gross farm costs per herd for the year was $1,860. Thus, the average gross cost to keep a cow for one year was $130.61, and this amounted to $3.32 per 100 pounds of milk produced. The range of cost for keeping a cow for one year on the entire 40 farms was from $73 to $257. The range in cost of producing 100 pounds of milk was from $1.77 to $5.56.

Credits

Each cow was credited with 5 tons of manure since this was the estimated amount that was saved per cow. The manure was valued at $1.50 per ton. Credit for calves produced amounted to $2.00 per cow. Total credits were $137.17 for each herd or $9.63 per cow. This credit amounted to $0.24 per 100 pounds of milk produced.

Net Farm Costs

Net farm costs are gross farm costs less total credits. Net farm costs amounted to $1,723 per herd as shown in table 7. This gave a net cost of $121 per cow and $3.08 per 100 pounds of milk produced.

Hauling Charges

Charges for hauling milk to the milk plant for the year amounted to $126 per herd, $8.85 per cow, and about $0.025 per 100 pounds of milk. When adding this cost to net farm costs, it gives a cost of $3.33 per 100 pounds of milk delivered at the plant.

Returns For Milk Sold

The amount of milk sold per farm was 49,401 pounds, or 3,468 pounds per cow. This amount of milk delivered at the milk plant sold for $1,987. Thus the average price received for 100 pounds of milk by the farms was $4.02. This price per 100 pounds was slightly above the average milk plant price for the area due to several of the farms producing grade A milk for army camps and for starter milk at cheese plants. This better grade of milk sold at a premium.

Milk Used on the Farm

Milk used for personal purposes per farm amounted to 3,861 pounds per herd, and milk fed to calves was 2,729 pounds per farm. Thus the total amount of milk used on each farm had a farm value of $232.

Profit

Profit was determined by deducting farm costs and hauling charges (total costs) from total milk returns. Total milk returns per herd amounted to $2,219. Net farm costs per herd plus hauling charges amounted to $1,849. Thus the profit per herd was $370 and per cow, $25.99. The profit per 100 pounds of milk was the average price received ($4.02) less the total cost per 100 pounds ($3.33), and amounted to $0.69.

Labor Return

Assuming that profit on the enterprise is also a return to labor, the total return to labor would be profit on the enterprise plus man labor charges to the enterprise. The sum of $370 (profit) and $507 (labor charges) gives a labor return of $877. This amounts to $61.61 per cow, and $1.59 per 100 pounds of milk sold.

What a farmer receives for his labor is of paramount importance to him. He has opportunities to use his labor in various ways and that combination of ways which gives the greatest return for the farm business as a whole, is the one he is continually seeking. These ways of using labor, of course, take form in the various enterprises conducted on the farm.

Much of the labor used on the farms in this study was unpaid family labor. Oftentimes this labor may be used on an enterprise when the cost of production is relatively high, particularly where it is convenient to engage in that enterprise, and still receive income that adds to the well-being of the farmer and his family. In case of the dairy enterprise, the farmer charges the cows with grain, hay, and other feeds at farm value (market value less transportation costs) instead of what they actually cost. Consequently, an enterprise may show a loss when its physical input costs are charged at farm value, yet the farmer can afford to go right along producing the enterprise and will be better off by doing so unless some alternative enterprise opportunity appears whereby he can get more for his input costs or values.

Of the 10 farms that made minus incomes on dairy cows, only 3 made a minus labor return per cow. One farmer lost $31 per cow, but his labor return per cow was $30 and the labor return per hour spent producing milk was $0.17. Another farmer had a loss of $4 per cow, yet his labor return per cow was $51 and the return per hour spent on milk cows was $0.32. If profit and loss had been computed on the basis of actual costs of producing feed on the farm, the return for labor would have been considerably more. Therefore, if a farmer receives the cost of production for 100 pounds of milk or a hundred pounds of cotton, that price includes the current wage rate for his labor and for all unpaid family labor. However, farmers are entitled to a fair profit above actual costs, as is expected in any other business, in order that they build up reserves for depression periods and for old age.

Costs and Returns per Cow on Different Type Farms

A study of table 10 shows costs and returns for the dairy enterprise by types of farming on a per cow basis. The average costs and returns per cow for the 40 farms is repeated for comparative purposes.

The annual net cost to keep a cow for one year on dairy-cotton farms amounted to $120. The costs on cotton-dairy farms were $130, and $113 on dairy & cotton farms. The annual profit per cow was $36 for dairy-cotton farms. There was a loss of $7 per cow for cotton-dairy farms, and a gain of $42 on dairy & cotton farms. It will be noticed that the profit was considerably greater on the farms where there was balanced emphasis on milk cows and cotton. Also, it will be noticed that cows on the dairy & cotton farms produced an average of 4,392 pounds of milk. That was a production of 400 pounds per cow above the dairy-cotton farms, and 1,000 pounds more than on cotton-dairy farms. Feed costs and net farm costs per cow were less than on the other two types of farms.

The differences between farm types pointed out in the preceding paragraph are favorable to those farmers who placed about the same emphasis on both cotton and milk cows in their farm program. Since, dairy & cotton farms used fewer man hours per cow, spent less for feed, and got a higher production from their cows, it would seem that their cows were more profitable because labor was used more efficiently and their cows were more efficient in converting feeds into milk. The pounds of concentrates fed per cow on dairy & cotton farms were about the same as fed on the other types of farms. The roughage fed per cow was from 200 to 400 pounds less per cow. Pasture conditions on dairy & cotton farms were somewhat better than on dairy-cotton farms and about the same as on cotton-dairy farms.

Labor returns per cow were likewise greater on dairy & cotton farms. This return was 118 percent greater, or more than twice as great as the labor return on farms where emphasis was placed mainly on cotton. It was, however, only 9 percent greater than labor return per cow on farms placing major emphasis on the dairy enterprise.

Cotton Production Costs and Returns

Cotton was produced on 32 of the 40 farms on which records were kept. An average of 21.8 acres of cotton was produced on each farm. Actual bales ginned per farm was 20.2 or nearly one bale per acre. The number of 500-pound bales produced per farm was 21.3. The average price received per pound of lint cotton for all farms was 21.21 cents, and the cost to produce one pound of lint was 13.28 cents.

A study of table 11 shows the amount of cost items for the average cotton enterprise on 32 farms. The average cost of each item is shown for the total cotton enterprise, one acre of seed cotton, one 500-pound bale and seed, 500 pounds of lint, total lint, total seed, the cost of producing one pound of lint, and the proportionate part each item of cost was of the total cost of producing one pound of lint. Items of cotton cost are discussed in the following paragraphs.

Man Labor

It will be observed, table 11, that man labor was the largest item of costs in producing cotton. The total man-labor cost for the average cotton enterprise on 32 farms in Northeast Mississippi was $1,089. This labor cost was $50 per acre of cotton grown, $51 per 500-pound bale and seed, and $40 per 500 pounds of lint. Man-labor cost per pound of lint was 8.04 cents, which constituted 60.5 percent of the total cost to produce one pound. Consequently, any steps taken by farmers to reduce the cost of producing cotton will necessarily include the consideration of man labor.

The man labor required to grow an acre of cotton amounted to 141 hours, and only 3 hours more were required to produce a 500-pound bale since production was so near one bale per acre. The range in hours required per acre of cotton on the 32 farms was from 63 to 176. Barring the fact that there were differences in yield per acre among farms, there still would be much room for increasing the efficiency of labor. And since this cost item is 60.5 percent of the total cost of production, farmers could well look to using available labor on the farm, as well as hired labor, to a more distinctive advantage.

Table 11. Production, values, and average costs and returns per farm for cotton on 32 farms in Northeast Mississippi, 1944

	Production:		Values: (Dollars received)	
Cotton acres, 21.77	Total seed cotton	26,109 lbs.	Total seed cotton	2,646.14
Bales ginned, 20.23	Total lint	10,671 lbs.	Total lint	2,263.72
Man hours per acre 141	Total seed	15,438 lbs.	Lint per pound	0.2121
	500 lb. bales	21.34 lbs.	Total seed	382.42

Item	Total crop	One acre seed cotton	One 500-lb. bale and seed	500 lbs. of lint*	Total lint*	Total seed	Lint	
							Per lb.*	Percent of total
Costs:								
	dollars	dollars	dollars	dollars	dollars	dollars	cents	percent
Land	67	3.08	3.14	2.47	53	14	0.50	3.7
Fertilizer	107	4.92	5.01	3.95	84	23	0.79	6.0
Manure	38	1.76	1.80	1.42	30	8	0.28	2.1
Seed	43	1.97	2.01	1.59	34	9	0.32	2.4
Man labor	1,089	50.02	51.02	40.18	857	231	8.04	60.5
Horse labor	195	8.95	9.13	7.19	153	41	1.42	10.8
Tractor	22	1.01	1.02	.81	17	5	0.16	1.2
Other equipment	54	2.48	2.53	1.99	43	12	0.40	3.0
Ginning	108	4.96	5.06	3.98	85	23	0.80	6.0
Miscellaneous	77	3.53	3.60	2.84	61	16	0.57	4.3
Total costs	1,800	82.68	84.32	66.40	1,417	382	13.28	100.0
Returns:								
Total lint	2,264	104.01	106.07	----	----	----	----	----
Total seed	382	17.57	17.92	----	----	----	----	----
Total	2,646	121.58	123.99	106.07	2,264	382	21.21	----
Gain	846	38.90	39.67	39.67	846	0	7.93	----

*Cost of lint cotton is determined by the total costs of seed cotton minus total value (amount received) of seed.

Horse Labor

Labor performed by workstock held the second place in magnitude of cost. Horse labor used to produce cotton averaged $195 per farm or $8.95 per acre. The cost of horse labor to produce one pound of lint cotton was 1.42 cents, or 10.8 percent of the total cost to produce one pound.

Land

Land costs (interest on investment, taxes, improvements) per farm for the cotton enterprise on 32 farms in Northeast Mississippi was $67. This amounted to $3.08 per acre and $3.14 per 500-pound bale and seed. The land cost per 500-pound bale of lint was $2.47, and the average cost per pound of lint was 0.5 cent. This one-half cent land cost per pound of lint was 3.7 percent of the total cost to produce a pound of lint. The average value per acre of land only for the 32 farms was $23.96. Total farm investment per acre was $63.20.

Fertilizer

All but six of the 32 farms used fertilizer in the production of cotton. Fertilizer costs for cotton were $107 per farm or $4.92 per acre. This was considerably more than the cost of land per acre. The fertilizer expense per pound of lint was 0.79 cent, or 6 percent of the total cost of 13.28 cents to produce a pound of lint.

Manure

Twenty-six of the 32 farms growing cotton applied manure in its production. The amount used was very small, since the average value of manure applied per acre on farms growing cotton was only $1.76 or $38 per farm. Thus the manure cost per pound of lint cotton was 0.28 cent. This was 2.1 percent of the total cost of producing one pound of lint.

Cottonseed

Cottonseed for planting cost $43 per farm and $1.97 per acre of cotton. This expense amounted to 0.32 cent per pound of lint and 2.4 percent of the cost of producing one pound of lint.

Tractor Expense

Tractor expense for producing cotton averaged $22 per farm for the farms growing cotton. Seventeen of these farms owned tractors. Since the average cost per hour for operating tractors was 49 cents, it is readily seen that the tractors were used only for a few hours on the cotton enterprise. When tractors were used, it was principally for plowing early in the year.

Other Equipment

Other equipment consisted of all equipment on farms except tractors. This cost averaged $54 per farm or $2.48 per acre for the equipment used in producing cotton. Equipment cost per pound of lint amounted to 0.40 cent, or 3 percent of the total cost to produce one pound of lint.

Ginning

The expense of ginning averaged $108 per farm and $4.96 per acre of cotton. This cost averaged $5.06 per 500-pound bale. This charge was fairly standard in all communities. Ginning cost was 0.80 cent per pound of lint and 6 percent of the total cost to produce one pound of lint. This cost per pound of lint was twice that of farm equipment and almost twice the cost of land. As an expense of production, ginning came next in importance after man and horse labor costs.

Miscellaneous Costs

Miscellaneous costs amounted to $3.53 per acre and 0.57 cent per pound for lint. This expense was 4.3 percent of the total cost of producing one pound of lint.

Total Costs of Producing Cotton

The average cost of producing the cotton enterprise on each of the 32 farms was $1,800, which amounted to $83 per acre. (See table 11.) The cost to produce 500 pounds of lint was $66, which gave a cost of 13.28 cents per pound for lint cotton. This return from one acre of cotton for lime and seed was $104 and $17.57, respectively. The total return from the enterprise per farm was $2,646, thereby leaving a profit of $846 for the cotton enterprise and $38.90 per acre produced. With a cost per pound of lint at 13.28 cents and an average price of 21.21 cents received per pound, this gave a profit of 7.93 cents per pound of lint to the farmers growing cotton.

Costs of Cotton Production on Different Type Farms

Table 12 shows the average amount of cotton produced per farm for 32 farms in Northeast Mississippi as well as the amounts produced on dairy-cotton, cotton-dairy, and dairy & cotton farms. Items of cost of production are also given. There was much variation in the acreage devoted to cotton production on the three types of farms. The range was from 9.1 acres per farm on dairy-cotton farms to 39.9 acres on cotton-dairy farms. Dairy & cotton farms produced 12.1 acres, which was only 3 acres more than was produced on dairy-cotton farms, and less than one-third of the acres grown on cotton-dairy farms. The number of acres produced on the five low-cost farms and the five high-cost farms was about the same, and approximately the same as was produced on dairy & cotton farms.

Table 12. Acres in cotton, bales produced, and the costs and returns per acre for cotton on 32 farms in Northeast Mississippi, 1944

Items	Average	Dairy-cotton	Cotton-dairy	Dairy and cotton	Five low cost farms[1]	Five high cost farms[1]
Number of farms	32	8	12	12	--------	--------
Acres in cotton	21.8	9.1	39.9	12.1	12.10	13.90
500 lb. bales produced	21.3	6.0	40.3	12.6	13.83	10.77
500 lb. bales per acre	.98	.67	1.01	1.04	1.14	.78
Man hours per acre	141	112	151	120	113	122
Costs						
Land	$ 3.08	$3.37	$3.19	$2.59	$3.26	$2.42
Fertilizer	4.92	2.39	5.32	4.83	5.33	4.61
Manure	1.76	3.03	.91	3.92	2.01	4.10
Seed	1.97	2.30	1.66	2.85	2.63	2.05
Man labor	50.02	28.15	53.68	48.89	37.42	44.55
Horse labor	8.95	7.88	9.18	8.71	6.23	9.95
Tractor	1.01	.62	1.08	.94	1.20	1.71
Other equipment	2.48	3.62	2.31	2.46	2.01	2.13
Ginning	4.96	3.56	5.05	5.36	5.80	3.95
Miscellaneous	3.53	1.96	3.86	3.25	2.52	5.37
Total costs	$82.68	$56.88	$86.24	$83.80	$68.41	$80.84
Cost per pound of lint, cents	13.28	13.31	13.55	12.42	8.24	17.17
Returns						
Lint	$104.01	$17.27	$106.42	$112.38	$122.11	$84.94
Seed	17.57	12.44	17.86	19.16	21.32	14.28
Total returns	121.58	83.71	124.28	131.54	143.43	99.22
Profit	38.90	26.83	38.04	47.74	75.02	18.38
Labor return per acre	88.92	54.98	91.72	96.63	112.44	62.93

[1] Based on cost per pound of lint.

The items of cost in the production of cotton varied considerably in value for the three types of farms. Man labor per acre, the most important cost item, was least on dairy-cotton farms and the most on cotton-dairy farms, $28 and $54 respectively. This cost was $49 per acre on dairy & cotton farms. Horse labor costs followed the same pattern. The low cost of man labor to produce an acre of cotton on dairy-cotton farms probably was due more to the smaller yield of cotton per acre than to more efficient use of labor on dairy & cotton farms.

Fertilizer costs varied from $2.39 per acre on dairy-cotton farms to $5.32 on cotton-dairy farms. The five farms producing cotton at the least cost per pound used $5.33 worth of fertilizer per acre. The total cost of producing a pound of lint on the three types of farms did not vary much, but was least on dairy & cotton farms. (See table 12.) It will be seen that the cost of production per pound on the five low cost farms was only 8.24 cents, while on the five high cost farms, the cost to produce one pound of lint was 17.17 cents.

Cotton Returns on Different Type Farms

Total returns per acre of cotton was the smallest on dairy-cotton farms. (See table 12.) This is largely the reflection of a low yield per acre for this type of farming. The average return per acre for all types was $122; for dairy-cotton, $84; for cotton-dairy, $124; and for dairy & cotton, $132. Profits per acre were $39, $27, $38, and $48, respectively. The five farms producing cotton at the lowest cost per pound—8.24 cents—had a profit of $75 per acre, whereas $18.38 was the profit per acre on the five farms producing cotton at the highest cost per pound, which was 17.17 cents.

Considering returns and profits as a whole, it appears that the yield per acre was the most important factor determining the cost to produce a pound of cotton and the return the farmer got for his labor.

Costs and Returns for Other Enterprises

Costs and Returns on Corn

Thirty-seven of the 40 farms keeping records produced corn. Acres per farm averaged 25.3 and the production per acre was 23.3 bushels. On the average, 27.8 man hours and 26.7 horse hours of labor were required per acre.

Table 13. Costs and returns for corn on 37 farms in Northeast Mississippi, 1944

Item	Quantity per acre	Value per farm	Value per acre	Per bushel Value	Per bushel Percent of total
		dollars	dollars	cents	percent
Costs:					
Land		81.39	3.21	13.8	14.5
Fertilizer		20.95	0.83	3.5	3.7
Manure		7.69	0.30	1.3	1.4
Seed		9.54	0.38	1.6	1.7
Man labor	27.8 hrs.	197.07	7.78	33.4	35.0
Horse labor	26.7 hrs.	159.18	6.29	27.0	28.3
Tractor	3.5 hrs.	41.62	1.64	7.0	7.4
Other equipment		28.92	1.14	4.9	5.1
Miscellaneous		16.68	0.66	2.8	2.9
Total costs		563.06	22.23	95.5	100.0
Returns:					
Corn	23.3 bu.	714.00	28.19	121.0	
Profit		150.94	5.96	25.5	

Acres per farm	25.3	Cost per bushel	$0.96
Return per hour of labor	$0.49	Value per bushel	$1.21

The total average cost per farm for the corn enterprise was $563, or $22.23 per acre. (See table 13.) With a production of 23.3 bushels per acre, this resulted in a cost of 95.5 cents per bushel. Again, as can be seen, the largest item of cost was labor. Man labor cost amounted to 35 percent of the total cost to produce a bushel of corn. Horse labor accounted for 28.3 percent. It will be recalled that the proportionate part of the total cost to produce one pound of cotton was 60.5 percent for man labor and 10.8 percent for horse labor. In the case of corn, horse labor has assumed a larger part of the cost. Again it will be noticed that the land cost to produce a bushel of corn was 13.8 cents. This amounts to 14.5 percent of the total cost to produce a bushel of corn, whereas the land cost to produce a pound of cotton was 0.5 cent, or 3.7 percent of the total cost to produce a pound.

The total return per farm from the corn enterprise was $714, or $28.19 per acre. The average farm value per bushel was $1.25. With a cost of 95.5 cents per bushel, this gave the farmers a profit of $151 for the corn enterprise, $5.96 per acre, and 25.5 cents per bushel. The labor return per hour spent on corn was $0.49.

Costs and Returns for Hogs

Thirty-eight of the 40 farms produced hogs. Only a few farmers produced for the market. Sales by others were for the purpose of disposing of a small surplus produced.

Table 14 shows that it cost $12.41 gross to produce 100 pounds of live pork. Of this amount 83.5 percent was for feed. On an average, 306 pounds of corn valued at $7.54, 82 pounds of other feed valued at $2.66, and pasture valued at 16 cents constituted the kinds, amounts, and values of feeds fed to produce this 100 pounds of live pork. It required 5.8 hours of man labor per 100 pounds of pork valued at $1.46 which represented 11.8 percent of the total cost to produce 100 pounds of pork.

Considering credits of manure and miscellaneous credits which amounted to $0.38 per 100 pounds, the net cost to produce 100 pounds was $12.03. The value per 100 pounds of live pork produced was $12.53, which left a profit of $0.50 per 100 pounds. This small profit on producing hogs was due to the unfavorable hog-corn ratio in Northeast Mississippi in 1944.

Table 14. Costs and returns for hogs on 38 farms in Northeast Mississippi, 1944

Items	Quantity per 100 lbs. liveweight	Value per lb. produced	Percent of total
Cost:			
		dollars	percent
Corn	306 lbs.	7.54	60.8
Pasture		0.16	1.3
Other feed	82 lbs.	2.66	21.4
Total feed	388	10.36	83.5
Man labor	5.8 hrs.	1.46	11.8
Horse labor		0.16	1.3
Buildings		0.05	.4
Interest		0.26	2.1
Miscellaneous		0.12	.9
Total costs		12.41	100.0
Credits:			
Manure		0.37	.....
Miscellaneous		0.01	.....
Total credits		0.38	.....
Net cost		12.03	.....
Value produced		12.53	.....
Profit		0.50	.....

Workstock Costs

Workstock was used on all farms and there was an average of 4.3 head per farm. Each head of workstock worked 462 hours, or 46 work days of 10 hours each during the year. The average cost for all farms was 22.9 cents per hour.

Table 15 shows the items of cost included in keeping workstock for one year. Feed amounted to $88 per head which was 78.1 percent of total costs. Two thousand seventy-six pounds of concentrates, principally corn, were fed per head at a cost of $52. Roughage fed per head amounted to 2,263 pounds valued at $30. Pasture was charged at actual cost or $6.47 per head. Man labor to care for one head of workstock for a year was 35.8 hours, which cost $9.89. Costs other than feed and man labor amounted to $14.95. A manure credit of $7.50 per head was deducted from total gross costs per head of $113, which resulted in a net cost of $106 to keep one head of workstock for a year.

Since workstock worked only 46 days per head during the year, some attention should be given to utilizing workstock labor more efficiently.

Table 15. Workstock costs on 40 farms in Northeast Mississippi, 1944

Items	Quantity per head	Values per farm	Value per head	Proportion of total
		dollars	dollars	
Costs:				
Concentrates	2076 lbs.	226.00	52.22	46.1
Roughage	2263 lbs.	129.00	29.79	26.3
Pasture		28.00	6.47	5.7
Total feed		383.00	88.48	78.1
Man labor	35.8 hrs.	43.00	9.89	8.7
Buildings		13.00	2.89	2.6
Equipment		7.00	1.58	1.4
Depreciation		14.00	3.29	2.9
Interest		24.00	5.58	4.9
Miscellaneous		7.00	1.61	1.4
Total costs		491.00	113.32	100.0
Credits:				
Manure		32.00	7.50	6.6
Net costs		459.00	105.82	93.4

Average head per farm 4.3 Hours worked per head 462
Cost per hour 22.9 cents

Factors That Affect Costs and Returns

Size of Business

Size is an important factor that affects all business enterprise and particularly is this true of farming. Farm income and the family standard of living are largely determined by this factor. The size of a farm business can be measured in several ways. Number of acres operated, capital investment, crop acres, amount of labor used, number of units comprising the major enterprises such as acres of cotton, number of milk cows in the herd, are measures commonly used. The more desirable measure to use in determining the size of a farm business depends a great deal on the type of farming followed.

Some of the measures used to show the size of the 40 farm businesses are shown in table 16. Acres per farm for all farms averaged 170, with a total investment of $10,743. Cotton-dairy farms had more total acres, cotton acres, crop acres, and a larger investment than the dairy-cotton or dairy & cotton farms. This could be expected since emphasis was placed on cropping. As a whole, cotton-dairy businesses were the largest, dairy-cotton farms next, and the dairy & cotton farms the smallest.

When considering the size of business in the Northeast Prairie, Northeast Highland, and Pontotoc Ridge Soil Areas, it will be noticed that the Prairie farms ranked highest in all measures. (Table 16). The Northeast Highland Area was next in all measures and the Pontotoc Ridge Area was the lowest in all measures.

Table 16. Size of farm business by type of farms and in major soil areas of Northeast Mississippi, 1944

Item	All farms	Type of farm			Soil area		
		Dairy-cotton	Cotton-dairy	Dairy & cotton	N. E. Prairie	N. E. Highland	Pontotoc Ridge
				average per farm			
Number of cows	14	19	12	10	17	13	7
Acres of cotton	21.8	9.1	39.9	12.1	29	14	11
Crop acres	75.4	42.1	141.6	53.6	94	54	49
Total acres operated	170.0	146.0	253.0	120.0	206	141	109
Total man Work units	494	508	594	377	561	442	373
Investment	$10,743	$8,949	$16,002	$7,876	$12,800	$9,083	$7,871

Man work units.[1] Since man labor is a common denominator of all farms, table 17 was constructed to show the relation of man work units per farm to and among other important factors. As the man work units per farm increased, the number of cows increased, acres of cotton increased very pronouncedly, and labor income increased. Costs and returns and the efficiency in the use of labor are not shown in this table because the averages for these important casual factors were found to be significantly different for the three types of farming; namely, dairy-cotton, cotton-dairy, and dairy & cotton.

Number of cows. When considering the relation of the number of milk cows per farm to production, costs and returns, the relationships were not altogether consistent. (See table 18.) The five smallest herds had the highest production per cow, the lowest cost per 100 pounds of milk, and the highest return per hour of labor. However, it should be pointed out that after getting away from these small herds, man hours per cow did decrease, and the labor return per hour spent on cows increased, as the number of milk cows in the herd increased.

Table 17. Man work units related to various factors on 40 farms in Northeast Mississippi, 1944

Man work units per farm	Number farms	Work units per farm	Milk cows	Acres of cotton	Labor income
Below 300	6	270	11	10.0	$1,097
300 - 499	15	380	10	14.8	1,289
500 - 699	15	584	18	20.6	1,325
700 - 899	2	748	19	38.0	2,492
900 and over	2	1,099	28	84.0	3,016
Total	40	494	14	21.8	1,419

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[1] A man work unit is 10 hours of production from work performed by one man.

Table 18. Size of herd related to various factors on 16 dairy-cotton farms in Northeast Mississippi, 1944

Number of cows	Number of farms	Cows per farm	Cost per 100 lbs. milk	Man hours per cow	Labor return per hour	Milk per cow
	number	number	dollars	hours	dollars	pounds
7 - 12	5	10	2.80	137	0.63	4,460
13 - 18	4	15	3.30	167	0.37	3,425
19 - 24	4	23	3.40	148	0.40	3,950
25 and over	3	32	3.40	134	0.60	4,066
Total	16	19	3.27	148	0.47	4,000

The same relationship was obtained when all 40 of the farms were likewise considered. A larger number of cases would no doubt show a more direct relationship between the size of herd and other important factors.

Acres of cotton. Acres of cotton per farm varied considerably. (See table 19.)

Labor requirements increased per 500-pound bale produced as the acres of cotton per farm increased on farms that grew more than 10 acres. Under increasing mechanization conditions the reverse of this relationship would be expected. However, practically all of the cotton production on the 32 farms was performed by man and horse labor. Thus it would appear that labor is being used less efficiently on the larger farms. The same relationship exists when considering cotton-dairy farms alone.

Larger farms have more cropper tenants, and according to data presented in table 19, such labor is not as efficient as the labor furnished by the operator, members of his family, and the small amount of labor hired during the year on the smaller farms. Labor income increases as the size of the cotton enterprise increases, but labor income does not necessarily reflect efficient use of cropper labor on farms when considering the size of the business.

Table 19. Acres of cotton per farm related to labor requirements and returns on 32 farms in Northeast Mississippi, 1944

Acres of cotton	Number farms	Acres per farm	Man hours per 500 lb. bale	Labor income
Below 10.0	9	6.1	152	$1,169
10 - 19.9	11	14.1	120	1,532
20 - 29.9	6	23.7	125	1,622
30 and over	6	57.5	158	1,906

Labor Efficiency

Using labor to the best advantage is one of the most important problems with which farm operators deal. Labor requirements are much greater for some enterprises than for others, and at the same time, the demands on all farms for labor is highly seasonal, particularly for crops. Labor requirements for crops constitute the largest cost item in their production. For cotton, this cost amounts to 60.5 percent of the total expenses of growing the crop. Labor requirements for corn, hay, and other crops were somewhat less, but still were the highest single cost item.

Work units per man available on farms. The amount of labor accomplished per man varied from farm to farm, and as the available man equivalent per farm increased, the units worked per man available decreased. (See table 20.) Also, as the available man equivalent per farm increased, the acres of cropland per farm increased. Farms with an average of 38 acres of cropland had an average of 1.63 man equivalent of labor available.

Since the amount of work accomplished per man available for work on the farm decreased as the size of business (measured by crop acres) increased, farmers operating large acreages should give more attention to using more efficiently the labor they have available under their management. It will be noticed that the acres of cropland per man did not vary much whether on a small farm or a large farm, yet the cost to produce an acre of cotton, or a pound of cotton, was greater as the size of farm business increased, and as the labor performed per man available decreased. The fact that larger farms had the most tenants, and since it was on these farms that labor was used less efficiently, this would tend to explain the unfavorable relationship of cropland per man and the greater cost of producing cotton on the larger farms.

Man hours per cow. The amount of labor used per cow ranged from 86 hours to 262 hours, and the average amount of man labor per cow was 145 hours for the 40 farms. (See table 21.) There was practically no relationship between hours used per cow and the amount of milk produced per cow. However, as man hours expended per cow, increased, the cost to produce 100 pounds of milk increased, and the labor return per hour decreased. Thus the labor used per cow should be kept at a minimum in keeping with the ability of the cow to produce milk. While feed is the most expensive cost item in the production of milk, the labor cost ranks next and much careful attention should be given to its use.

Table 20. Relation of man work units accomplished per man available[1] to various factors on 40 farms in Northeast Mississippi, 1944

Units worked per man available	Number farms	Average units worked per man available	Man equivalent	Acres cropland per farm	Acres cropland per man equivalent	Cost per acre of cotton	Total cost per lb. of lint	Man labor cost per pound of lint
						dollars	cents	cents
Less than 100	9	73	7.75	150	19.3	96	15.23	9.3
100 - 149	12	124	3.37	60	17.8	90	13.90	7.6
150 - 199	6	170	2.95	54	18.3	64	12.65	6.5
200 - 249	6	220	2.34	54	23.1	56	9.54	4.3
250 and over	7	310	1.63	38	23.3	48	11.43	5.2

1/ Man work units accomplished per man available was determined by dividing the total hours of productive work accomplished per farm by the man equivalent of labor found on the farm. The operator and man cropper tenants were considered as one man each available for 12 months of work. Family labor of the operator and family labor of the man cropper were converted to the equivalent of man labor.

Table 21. Man hours per cow related to various factors on 40 farm in Northeast Mississippi, 1944

Man hours per cow	Number farms	Hours per cow	Milk per cow	Cost per 100 lbs. milk	Labor returns per hour
		hours	pounds	dollars	dollars
Less than 100	5	86	3,920	$2.81	$0.73
100 - 149	19	125	4,332	3.07	0.56
150 - 199	12	167	3,575	3.70	0.30
200 and over	4	262	4,385	4.27	0.18
Total	40	145	3,931	3.34	0.47

Man hours per acre of cotton. The labor used per acre of cotton varied very much also. (See table 22.) Seven farms averaged only 77 man hours per acre while a like number of farms averaged 168 hours. As the man hours per acre increased, the pounds of cotton produced per acre increased, which was unlike the relationship of labor expended per cow and the milk produced per cow. However, as the pounds of cotton per acre and labor per acre increased, the cost to produce an acre of cotton increased. Unlike the application of labor to cows, as labor on cotton per acre increased, the cost to produce one pound of lint decreased and the labor return per hour increased up to 150 hours per acre and then decreased. Consequently, a farmer should be very careful about increasing the hours of labor used per cow and the labor used per acre of cotton above 150 hours under conditions similar to those on the 40 farms in Northeast Mississippi. The part of his total time as operator of the farm that should be devoted to the entire dairy enterprise is another problem and should be considered in the organization of the entire farm business.

Table 22. Man hours per acre of cotton related to various factors on 32 farms in Northeast Mississippi, 1944

Man hours per acre	Number farms	Average man hours per acre	Pounds of lint per acre	Cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
		hours	pounds	dollars	cents	dollars	cents
Less than 100	7	77	286	$57	16.5	$15	55
100 - 149	17	120	527	86	12.7	47	72
150 - 199	7	168	532	84	12.1	49	61
200 and over	1	218	573	91	13.5	52	45
Total	32	126	477	79	13.4	---	---

Rates of Production

Again the reader might be reminded that the 40 farms keeping records in 1944 were divided into three groups or types: (1) dairy-cotton farms where there was a relatively high number of milk cows per farm compared with acres in cotton; (2) cotton-dairy farms where the reverse of (1) above was true; and (3) dairy & cotton farms where the number of milk cows and acres in cotton per farm were about the same.

Types of farming and rates of production. In table 23 the types of farms were listed according to the pounds of milk produced per cow. Farms placing the most emphasis on cotton (cotton-dairy farms) kept cows which had the lowest production, or 3,400 pounds each. Farms where major emphasis was placed on the dairy enterprise (dairy-cotton farms) kept cows that produced an average of 4,000 pounds each. And farms which placed about the same emphasis on both dairy and cotton enterprises kept milk cows that produced an average of 4,400 pounds of milk each.

Table 23. Types of farming in Northeast Mississippi related to milk production per cow and other dairy factors on 40 farms, 1944

Type of farming	Number of farms	Size of herd	Milk per cow	Feed per cow: Concentrates	Feed per cow: Roughages	Man hours per cow
	No.	No.	lbs.	lbs.	lbs.	hrs.
Cotton-dairy	12	12	3,413	1,242	2,858	153
Dairy-cotton	16	19	3,993	1,737	2,637	148
Dairy & cotton	12	10	4,392	1,314	2,319	124
All types	40	14	3,931	1,516	2,624	145

There was little relationship between the amount of milk produced per cow and the size of herd or the amount of concentrates fed per cow. Roughages fed per cow decreased as milk production increased and labor used per cow followed the same trend. It will be noticed that where there was a balance between number of cows and acres of cotton per farm that labor per cow was the lowest and milk production per cow was the highest. This made for more profitable milk production as shown in table 24.

Table 24. Types of farming in Northeast Mississippi related to milk production per cow, costs and returns on 40 farms in Northeast Mississippi, 1944

Type of farming	Number of farms	Milk per cow	Cost of feed and pasture per cow	Cost per cow per year	Cost of 100 lbs. milk	Profit per cow	Labor returns per hr. on cows
		lbs.	dollars	dollars	dollars	dollars	dollars
Cotton-dairy	12	3,413	$78	$148	$4.09	$—7	$0.22
Dairy-cotton	16	3,993	82	138	3.27	36	0.47
Dairy & cotton	12	4,392	68	133	2.83	42	0.61
All types	40	3,931	78	139	3.34	26	0.42

The cost to keep a cow for one year decreased by types of farming as the production per cow increased among the types. (See table 24.) Cost per cow was $148 on cotton-dairy farms, $138 on dairy-cotton farms, and $133 on dairy & cotton farms. Cost of producing 100 pounds of milk on dairy & cotton farms was the lowest, amounting to $2.83. The cost on dairy-cotton and cotton-dairy farms per 100 pounds of milk was $3.27 and $4.09, respectively. Farmers who placed major emphasis on producing cotton and minor emphasis on producing milk lost an average of $7 per cow. Dairy-cotton farms made a profit of $36 per cow, and dairy & cotton farmers made $42 on each cow kept. Likewise, the return per hour for labor used on milk cows was highest on dairy & cotton farms, amounting to $0.61. Labor return per hour for this enterprise on dairy-cotton and cotton-dairy farms was $0.47 and $0.22, respectively.

Milk per cow. A study of the dairy enterprise on farms in Northeast Mississippi finds, as in similar studies elsewhere, that low producing cows are not profitable and that as production per cow increases, profits per cow increase.

Cows producing less than 3,000 pounds of milk per year showed a loss of $15.75 per year, whereas cows producing an average of 5,438 pounds netted the farmer $44. (See table 25.) Only four farms had cows producing below 3,000 pounds. The yearly cost to keep a cow increased as the amount of milk per cow increased. (See table 26.) It cost $124 per year to keep a cow producing an average of 2,575 pounds, and it cost $175 to keep a cow that averaged 5,438 pounds. Thus the cost to produce approximately an extra 3,000 pounds of milk above the average production of the low producing cows was $51. That is the same as stating that farmers who kept cows that produced above 5,000 pounds, produced the last 3,000 pounds of milk at a cost of $1.70 per hundred.

Table 25. Milk produced per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Pounds per cow	Number farms	Milk per cow	Feed cost per cow	Cost per 100 lbs. milk	Profit per cow	Labor return per cow
		lbs.	dollars	dollars	dollars	dollars
Below 3,000	4	2,575	$76	$4.51	$—15.75	$14
3,000 - 3,999	17	3,529	64	3.33	12.94	51
4,000 - 4,999	11	4,409	81	3.13	42.91	78
5,000 - 5,999	8	5,438	100	3.11	44.13	85
Total	40	3,931	$78	$3.34	$26.00	$62

Feed costs per cow increased as production increased, and the cost to produce 100 pounds of milk decreased. Profit per cow increased as production per cow increased. The cost to produce milk with a cow producing 5,000 pounds was 31 percent less than with a cow producing 2,500 pounds, and the labor return per cow was 500 percent greater for 5,500-pounds production cows.

Table 26. Milk produced per cow related to various factors on 40 farms in Northeast Mississippi, 1944

Pounds per cow	Number farms	Average pounds per cow	Pounds of concentrates per cow	Pounds of roughage per cow	Man hours per cow	Size of herd	Yearly cost per cow
		lbs.	lbs.	lbs.	hours	no.	dols.
Below 3,000	4	2,575	1,425	3,097	147	22	$124
3,000 - 3,999	17	3,529	978	2,449	148	13	126
4,000 - 4,999	11	4,409	1,633	2,793	137	14	147
5,000 - 5,999	8	5,438	2,022	2,885	145	14	175
Total	40	3,931	1,516	2,624	145	14	$139

Concentrates fed per cow increased as production increased. Likewise, the cost to keep a cow for one year increased. There was no relationship between production per cow and man hours used per cow.

Cost to produce 100 pounds of milk was $4.51 for farmers having cows that produced 2,575 pounds annually. Whereas, the cost was $3.11 per 100 pounds on farms having cows that averaged 5,438 pounds. Labor returns per hour spent on milk cows increased as the milk produced per cow increased. Again, it might be pointed out that though the farmers with the lowest producing cows made a minor profit per cow, they had a labor return of $14 per cow. Assuming the farmer could not use his labor more profitably on some other enterprise, and though his cows were low producers, his cows did pay all expenses other than labor and gave the farmer a return of $14 per head as part payment for the labor he spent on them during the year. Labor return per cow was $85 where cows averaged producing above 5,000 pounds of milk.

Milk per cow by types of farming. The highest producing cows were not found on farms that placed major emphasis on keeping milk cows, but were found on the dairy & cotton type of farm. (See table 27.) Concentrates fed per cow producing milk at various levels varied considerably among the three types of farms. However, the general trend was an increase in the feeding of concentrates per cow as the production increased. There was less relationship of this trend among cotton-dairy farms.

It will be noticed that on cotton-dairy farms it was only when milk production reached the 5,000-pound mark that these farmers received a profit per cow. The cost of 100 pounds of milk increased as production per cow increased for dairy & cotton farms, which is inconsistent with each of the other types of farms and when all 40 farms are likewise considered. This may be due to the feeding of considerably more concentrates to the cows producing above the 3,000-pound level on the dairy & cotton farms. Also, it is quite possible for the cost to produce 100 pounds of milk to increase as production increased, but at a lesser rate and thereby show a favorable return.

Table 27. Milk per cow by types of farming related to various factors on 40 farms in Northeast Mississippi, 1944

Pounds per cow	Number farms	Average pounds per cow	Concentrates per cow	Yearly cost per cow	Cost per 100 lbs. milk	Profit per cow	Labor return per hour
		pounds	pounds	dollars	dollars	dollars	dollars
Dairy-cotton farms							
Below 3,000	2	2,600	1,626	$115	$4.08	$4.00	$0.19
3,000 - 3,999	5	3,500	919	120	3.21	15.00	0.32
4,000 - 4,999	6	4,317	1,321	136	2.92	56.00	0.72
5,000 - 5,999	3	5,133	2,720	165	3.10	41.00	0.57
Average	–	4,000	1,737	138	3.27	36.00	0.47
Cotton-dairy farms							
Below 3,000	2	2,550	1,223	133	4.94	—35.00	—0.01
3,000 - 3,999	7	3,471	1,164	142	3.82	— 4.00	0.30
4,000 - 4,999	1	4,500	2,521	240	5.05	—17.00	0.15
5,000 - 5,999	2	5,650	1,218	176	3.04	42.00	0.63
Average	–	3,400	1,242	148	4.09	— 7.00	0.22
Dairy & cotton farms							
Below 3,000	0	------	------	-----	-----	------	-----
3,000 - 3,999	5	3,640	776	110	2.76	53.00	0.57
4,000 - 4,999	4	4,525	1,879	140	2.97	79.00	0.61
5,000 - 5,999	3	5,600	1,861	185	3.15	92.00	0.64
Average	–	4,400	1,314	133	2.83	42.00	0.61
Average all groups	–	3,900	1,516	139	3.34	26.00	0.42

Pounds of cotton per acre. The production of cotton per acre ranged from 196 pounds to 837 when considering all farms. Seventy-five percent of all farms growing cotton had an average yield above 400 pounds per acre and 44 percent of the farms producing cotton had a yield above 500 pounds. (See table 28.)

As production per acre increased, man hours and total cost per acre increased. Likewise, profit per acre and labor return per hour increased. The farmers who produced above 770 pounds per acre received nearly one dollar per hour for their labor used on cotton.

Table 28. Pounds of lint per acre related to various factors on 38 farms in Northeast Mississippi, 1944

Pounds of lint per acre	Number farms	Average pounds per acre	Man hours per acre	Total cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
		pounds	hours	dollars	cents	dollars	cents
Below 300	5	242	76	47	16.0	15	48
300 - 399	3	332	96	67	16.7	15	53
400 - 499	10	436	137	72	12.6	37	62
500 - 599	7	573	139	92	12.7	51	76
600 - 699	5	616	138	99	12.3	58	87
700 plus	2	798	161	114	10.9	83	93

Pounds of cotton per acre by types of farming. All types of farming showed an increase in man hours required per acre, total costs per acre, and profit per acre as the pounds of cotton produced per acre increased. (See table 29.) It was previously pointed out that man labor was the greatest cost item in the production of cotton amounting to 60 percent of total costs. This cost is shown by types of farming as related to pounds of cotton per acre for land, man labor and other factors.

Where there was much emphasis placed on producing cotton (cotton-dairy farms), both land and labor costs increased as production increased up to where the average production was 604 pounds per acre, and then decreased as production went higher. This relationship was not obtained for the other types of farms. A larger number of cases might have given the same relationship. The lack of a sufficient number of farms in each class interval or grouping, should be considered before attempts are made to draw conclusions.

The total cost to produce one pound of lint cotton on dairy & cotton farms decreased rather definitely as the yield per acre increased. This trend was not as consistent on the other two types of farms. The relation between increased yields per acre and labor returns per hour spent on cotton was fairly direct.

Table 29. Pounds of cotton per acre by types of farming related to various factors on 40 farms in Northeast Mississippi in 1944

Pounds per acre	Number farms	Average pounds per acre	Man hours per acre	Cost per pound		Cost per acre	Cost per pound	Profit per acre	Labor returns per hr.
				Land	Man labor				
		pounds	hours	cents	cents	dols.	cents	dols.	dols.
				Dairy-cotton farms					
Below 300	4	241	82	1.55	6.57	45	15.3	17	.45
300 - 399	--	----	----	----	----	----	----	----	----
400 - 499	3	442	172	.26	7.40	72	12.0	39	.49
500 - 599	1	582	100	.19	3.09	101	13.7	41	.63
600 - 699	--	----	----	----	----	----	----	----	----
700 plus	--	----	----	----	----	----	----	----	----
Average	–	334	112	.81	6.55	57	13.3	27	.49
				Cotton-dairy farms					
Below 300	–	----	----	----	----	----	----	----	----
300 - 399	1	337	76	.36	7.62	68	16.1	16	.64
400 - 499	5	433	129	.39	7.67	73	13.1	35	.62
500 - 599	3	577	170	.90	9.05	99	14.2	45	.70
600 - 699	1	604	144	.92	9.81	120	15.7	37	.77
700 plus	2	799	161	.33	6.44	114	10.9	83	.93
Average	–	505	151	.50	8.45	86	13.5	38	.61
				Dairy & cotton					
Below 300	1	242	54	.94	8.39	58	18.6	6	.59
300 - 399	2	330	105	.33	9.03	67	17.0	14	.47
400 - 499	2	433	104	.39	7.53	70	12.3	40	.80
500 - 599	3	567	120	.28	5.85	82	10.9	60	.87
600 - 699	4	620	136	.38	7.06	94	11.5	63	.90
700 plus	–	----	----	----	----	----	----	----	----
Average	–	520	120	.37	7.27	84	12.4	48	.81
Average all groups	--	490	141	.50	8.04	83	13.3	39	.63

Dairy-cotton farmers received less for their labor when using it on cotton than did cotton-dairy and dairy & cotton farms. Low yields were partially responsible for this. Dairy & cotton farms received a labor return of 81 cents; cotton-dairy farms, 61 cents; and dairy-cotton farms, 49 cents for each hour spent in producing cotton. It should be noticed that the return per hour for labor used producing cotton was greater for those farms where there was a fairly well balanced emphasis on dairying and cotton. Likewise, this type of farming produced cotton at the lowest cost and received the highest profit per acre of cotton raised.

Types of Farming

The yield of cotton per acre varied considerably on the 32 farms producing it. Table 30 shows this variation by types of farming. Cotton-dairy farms grew four times the acreage of cotton as was grown on dairy-cotton farms and a little more than three times the amount grown on dairy & cotton farms. The yield per acre was slightly more than a bale per acre on both cotton-dairy and dairy & cotton farms, whereas the yield was only two-thirds bale per acre on dairy-cotton farms.

Table 30. Types of farming related to various factors in producing cotton on 32 farms in Northeast Mississippi, 1944

Type of farming	Acres per farm	Yield 500-lb. bales	Cost per acre	Cost per pound of lint	Profit per acre	Labor return per hour
	number	number	dollars	cents	dollars	cents
Dairy-cotton	9.1	6.1	57	13.3	27	49
Cotton-dairy	39.9	40.3	86	13.5	38	61
Dairy & cotton	12.1	12.6	84	12.4	48	81
All types	21.8	21.3	83	13.3	39	63

The cost of producing a pound of cotton varied little between types of farms, but varied considerably between individual farms. The cost per pound on dairy-cotton and cotton-dairy farms was 13.3 and 13.5 cents, respectively. The cost to produce a pound of cotton on dairy & cotton farms was 12.4 cents, or one cent less than for the other farm types. The range in cost to produce a pound of cotton on the 32 farms was from 6.67 cents to 21.16 cents. Seventy-five percent of the farms produced cotton at a cost range from 10 to 16 cents per pound with an average cost of 13.3 cents for all farms.

Labor returns per hour spent on cotton averaged 63 cents for the 32 farms. Low yields per acre undoubtedly account for the low labor return on dairy-cotton farms. On the other hand, yields were approximately the same for cotton-dairy and dairy & cotton farms. Yet, the returns per hour of labor on dairy & cotton farms was 33 percent higher than on dairy-cotton farms. This difference was due largely to the fact that the cotton-dairy farms used 31 hours more labor per acre, or 26 percent more than was used by dairy & cotton farms.

Combination of Enterprises

The combination of crops and animal enterprises for 39 farms and for the three types of farming in Northeast Mississippi are shown in table 31. The most important crop enterprises were cotton, corn, and hay. Corn and hay were grown for livestock feed. Hay was a cash crop on two farms.

Cotton and milk cows are the major income enterprises on farms in Northeast Mississippi, and anything affecting these two enterprises plays an important role in determining the well-being of farmers in this area. The most profitable combination of cotton and milk cows and contributing enterprises constitutes a question that has not been satisfactorily answered in the area under study.

Generally, a farmer receives the most of his income from the farm enterprise on which he spends the most of his labor. The average farm had 14.2 milk cows on which 205 ten-hour days of productive work were spent. Also, farms producing cotton had an average of 21.8 acres in that crop on which 307 ten-hour days of productive work were spent. Thus 49 percent more labor was used on the cotton enterprise than on the dairy enterprise for all farms.

Table 31. Combination of enterprises by types of farming and as related to labor income on 39 farms in Northeast Mississippi

Enterprise	Number farms reporting enterprise	Average for 39 farms	Dairy-cotton	Cotton-dairy	Dairy & cotton	Labor income	
						Upper 1/3 all farms	Lowest 1/3 all farms
				acres or head			
Crops:							
Cotton	32	13.8	4.4	30.0	12.1	19.6	7.6
Corn	37	19.5	12.2	33.0	16.9	28.5	17.2
Oats	14	5.6	5.5	3.7	7.3	12.8	2.3
Johnson grass hay	8	3.9	5.6	5.6	.0	—	—
Lespedeza hay	11	2.4	3.8	2.1	.9	—	—
Soybeans, hay	21	8.0	5.8	15.7	4.5	—	—
Other hay	18	5.2	3.8	4.6	7.5	—	—
Total hay	–	19.5	19.0	28.0	12.9	23.5	19.5
Silage	6	0.4	0.5	0.6	0.6	0.2	0.2
Other crops	–	2.5	0.5	3.4	3.8	1.1	0.4
Crop acres[1]	–	61.3	42.1	98.7	53.6	85.7	47.2
Animals:							
Dairy cows	40	14	19.0	10	10	16	13
Other cattle	39	11	13	8	10	13	9
Hogs	34	9	8.0	9	9	11	8
Hens	40	80	53.0	116	84	90	58
Workstock	40	4	3.0	5	4	5	3

[1] Crop acres include double cropped acres.

All farms produced milk for the market. Only 32 farms produced cotton. Therefore, for eight farms, the sale of milk was the only source of cash income except for miscellaneous sales of surplus stock, eggs and feed, which contributed considerably to labor income on some farms. All of the farms sold surplus livestock such as calves and heifers, eggs, hens, hogs, and a few sold some hay and corn. Labor income for eight farms in the dairy-cotton farm group not producing cotton was 73 percent of average labor income for the entire group of dairy-cotton farms. In other words, farms including cotton in their farm program along with milk cows in this type of farming had a larger labor income. However, profit per herd on the eight farms depending on cows for their cash income was $883, or 33 percent above the average herd profit of $665 for dairy-cotton farms; and more than twice as much profit per herd as for the 40 farms, which was $370.

Type of farming related to enterprise profits. Farms placing major emphasis on cotton lost $7 per cow annually and $89 per herd. But they made a profit of $38 per acre on cotton and a profit of $1,516 on the cotton enterprise. (See table 32.) Farms placing about the same emphasis on both milk cows and cotton received the greatest return per cow and per acre of cotton. Labor income was slightly higher than for the other types of farming—dairy-cotton and cotton-dairy. Since the dairy & cotton farms were slightly smaller than dairy-cotton farms, and only about 50 percent as large as cotton-dairy farms, it appears that much attention should be given to the desirability of organizing farms so that major emphasis is placed on both the cotton and dairy enterprises in the area of this study.

Table 32. Types of farming related to enterprise profits in Northeast Mississippi, 1944

Type of farming	Profit on Dairy enterprise	Profit on Cotton enterprise	Profit per Milk per cow	Profit per Acre of cotton	Labor income
Dairy-cotton	$665	$ 246	$36	$27	$1,400
Cotton-dairy	— 89	1,516	— 7	33	1,426
Dairy & cotton	435	581	42	48	1,439
All farms	370	850	26	39	1,419

Weather conditions were very favorable in Northeast Mississippi to cotton production in 1944 and only fair for feed crops and pastures. These conditions should be considered when making an appraisal of the results of this report. The fact that cotton-dairy farms with a larger investment did not make a larger labor income was due to the loss they sustained on their dairy herds and to using farm labor less efficiently.

Combination of enterprises on high and low income farms. A comparison of enterprises on farms found in the upper one-third labor income group ($2,444) and the lowest one-third labor income group ($416) of the farms under study is also given in table 31. Crop acres were 85.7 for the upper income group and 47.2 acres for the low income group with an average of 61.3 acres for all farms. Thus, the size of business looms up as an important factor affecting income. Cotton acreage in the upper one-third income group was more than twice as great as in the lowest one-third income group, whereas milk cows were only three less in the low income group than in the upper income group. Forty-one percent of the crop acreage on the low income farms was in hay and 27 percent was in hay on the upper income group.

Combination of enterprises on high and low cost farms. The combination of enterprises on farms producing cotton and milk at the highest and lowest costs per pound of lint and per 100 pounds of milk are shown in table 33. The 10 farms producing cotton at the lowest cost, or 9.44 cents per pound, had 14.3 acres in cotton, and the 10 high-cost farms—16.99 cents per pound—had 16.3 acres in cotton. The difference in acreage was not significant. However, acres of cotton produced on the highest-milk-cost farms ($4.51 per 100 pounds) were twice as many as were found on the 10 farms producing milk at the lowest cost, or at $2.30 per 100 pounds.

The difference in the emphasis placed on milk cows and other livestock on high and low cost farms for both cows and cotton (table 33) was of little significance, which means that the difference in milk costs due to other factors such as the capacity of cow, feeding practices, time of calving, pasture per cow, efficient use of labor, and emphasis placed on other enterprises. The fact that the 9 farms producing milk at the highest cost had twice the acreage of cotton as was found on the 10 farms producing milk at the lowest cost, bears out earlier findings that milk was produced less efficiently on farms giving major emphasis to cotton.

Table 33. Combination of enterprises on 39 farms related to combination of enterprises on high and low cost farms in Northeast Mississippi, 1944

Enterprise	Average for 40 farms	10 farms producing cotton at lowest cost (9.44 cents)	10 farms producing cotton at highest cost (16.99 cents)	10 farms producing milk at lowest cost ($2.30)	9 farms producing milk at highest cost ($4.51)
			Acres or head		
Crop:					
Cotton	17.2	14.3	16.3	11.4	21.0
Corn	21.8	18.9	22.6	19.9	29.7
Oats	6.8	.7	10.3	1.0	4.0
Johnson grass hay	10.7	7.9	0.3	......	6.6
Lespedeza hay	2.4	0.9	1.3	0.9	6.0
Soybean hay	8.3	4.4	6.6	1.8	11.7
Other hay	5.2	6.9	7.4	3.7	5.4
Silage	.4	0.3	0.6	.3	0.2
Animals:					
Dairy cows	14	10.7	12.2	11.0	13
Other cattle	11	9.4	10.5	7.6	11
Hogs	9	8.9	8.3	13.3	7
Hens	80	103.9	95.4	66.5	90
Workstock	4	2.8	4.2	3.9	4
Lint per acre, lbs.	490	507	393	414	524
Milk per cow, lbs.	3931	4260	3890	4470	3811

The number of milk cows on the 10 farms producing cotton at the lowest cost and the 10 farms producing cotton at the highest cost were practically the same. Likewise, acres per farm in cotton were about the same. However, the 10 farms producing cotton at the lowest cost, produced an average of 114 pounds per acre more than on the 10 farms producing cotton at the highest cost. The farms producing cotton at the lowest cost kept cows that produced more milk by 370 pounds than was the production per cow on farms producing cotton at the highest cost.

The 10 farms producing milk at the lowest cost kept cows that averaged 4,470 pounds of milk each, whereas the average production per cow on the 9 highest cost farms was 3,811 pounds—an annual difference of 659 pounds. On the other hand, the yield of cotton was greatest per acre on farms with the highest milk production costs. This again points out the fact that milk was produced less efficiently on farms placing the most emphasis on cotton. Also, it has been shown that labor is used less efficiently on farms with a large acreage of cotton.

Soil Fertility

Detail soil maps for each of the 40 farms in this study were furnished by the Soil Conservation Service of Mississippi and the Bureau of Plant Industry. These maps were used to study in detail the soil types on each farm. A staff member of the Experiment Station Soils Department assisted in this work by making a visit to each farm to study the types of soils with special emphasis on the fertility and adaptability of crops to the soils on which they were being grown. Farms were then classed as high, medium, and low in fertility for the purpose of finding relationships between farms of different fertility levels and the costs of production and income.

Soil fertility related to costs and returns. Half of the farms in the Black Prairie Area were classed high in fertility. One-half of the farms in the Northeast Highland Area were low in fertility, and 85 percent of the farms in the Pontotoc Ridge Area also were classed low in fertility.

For the areas as a whole, the cost to produce one pound of cotton increased as soil fertility decreased. (See table 34.) The difference in costs between farms of high fertility and low fertility was approximately two cents per pound. With a market price of 20 cents for cotton, a spread of 2 cents per pound amounts to $10 per bale. Interest at 5 percent on an investment of $200 amounts to $10. Consequently, a farmer can afford to pay considerably more for land of high fertility when purchasing land for the purpose of growing cotton. The rate of cotton production was greater on farms of high soil fertility, as would be expected. This, of course, was a major factor in influencing the smaller cost of producing a pound of cotton on these farms.

Table 34. Relation of soil fertility to the cost of producing cotton and income on 32 farms in Northeast Mississippi, 1944

Soil fertility	Number farms	Number of farms in			Cost to produce one lb. of lint	Return per hour of labor	Labor income per farm	Production per acre
		Prairie Black	N. E. Highland	Pontotoc Ridge				
					cents	cents	dollars	pounds
High	13	11	1	1	12.58	70	1,712	508
Medium	5	3	2	0	11.97	63	1,970	436
Low	14	4	3	7	14.67	68	1,038	462

Soil fertility related to various factors. The foregoing soil fertility cost relationship for the 32 farms were the same for the Black Prairie Area except that the difference between cost of producing a pound of cotton on high and low fertility farms was greater. (See table 35.) In the Pontotoc Ridge and Northeast Highland Areas, the same general relationship existed. However, the value of these findings is limited by the few farms in this study located in the Northeast Highland Area and in the better grades of land in the Pontotoc Ridge Area.

Table 35. Relation of soil fertility to the cost of producing cotton and income on 32 farms in 3 soil areas of Northeast Mississippi, 1944

Soil fertility	Number farms	Cost of one pound of lint	Labor return per hour	Labor income	Lint produced per acre
		cents	cents	dollars	pounds
			Black Prairie		
High	11	12.78	65	1,798	493
Medium	3	12.50	54	1,877	349
Low	4	16.35	53	1,228	374
			Northeast Highland		
High	1	13.86	94	1,807	633
Medium	2	11.19	79	1,299	566
Low	3	11.20	86	1,546	677
			Pontotoc Ridge		
High	1	9.08	90	668	552
Medium	0	-------	---	3,684	-----
Low	7	15.9	68	796	421

Farms high in fertility produced an average of 508 pounds of lint cotton per acre, but both medium and low fertility farms produced well above 400 pounds per acre. (See table 36.)

Profit per acre of cotton decreased as soil fertility decreased. Farms of low fertility spent more for fertilizer per acre than did farms of medium fertility, yet received less profit per acre. Labor income was inconsistent in its relationship to soil fertility; however, labor income on farms of low fertility was much less than labor income on farms of medium and high fertility.

Table 36. Relation of soil fertility to various factors on 32 farms growing cotton in Northeast Mississippi, 1944

Soil fertility	Number farms	Pounds cotton per acre	Cost per pound of lint	Fertilizer cost per acre of cotton	Profit per acre	Labor income	Farm investment per acre
			cents	dollars	dollars	dollars	dollars
High	13	508	12.58	6.97	45	1,712	76
Medium	5	436	11.97	3.85	40	1,970	74
Low	14	462	14.67	5.57	37	1,038	62

Soil Crop Adaptation

Growing a crop on the type of soil to which it is best adapted usually gives the highest labor returns. Progressive farm operators give much thought to placing crops in their farm layouts so that this relationship exists. Table 37 shows the relationship of the adaptation of crops to soils on the 40 farms in this study. On 22 farms the adaptation of crops to soils on which they were grown was "good"; on 14 farms, "fair"; and on 4 farms it was "poor". The adaptation of crops to soils on the farm as a whole was used as a basis for the above classification.

Table 37. Soil crop adaptation related to various factors on 40 farms in Northeast Mississippi, 1944

Soil crop adaptation	Number farms	Lint cotton		Corn		Return per hour of labor on cotton	Labor income
		Per acre	Cost per pound	Per acre	Cost per bushel		
		lbs.	cents	bu.	dols.	cents	dols.
Good	22	517	12.42	26	0.94	73	1,709
Fair	14	407	15.05	26	1.10	61	1,076
Poor	4	424	15.17	14	1.41	54	1,033

The rate of production was highest where soil crop adaptation was good. It cost 12.42 cents to produce a pound of lint cotton where adaptation was good, 15.05 cents where it was fair, and 15.17 cents where adaptation was poor. The cost to produce a bushel of corn was 94 cents where soil crop adaptation was good, $1.10 where it was fair, and $1.41 where soil crop adaptation was poor. The cost of producing cotton per pound was 23 percent greater on farms with poor soil crop adaptation than on farms when the soil crop adaptation was good. It cost 50 percent more to produce corn on farms where the soil crop adaptation was poor than where the soil crop adaptation was good. Also, it will be observed that labor return per hour spent on cotton was 73 cents where soil crop adaptation was good, 61 cents where it was fair, and 54 cents on farms where it was poor. Labor income was highest on farms where soil crop adaptation was good and lowest on farms with poor soil crop adaptation.

Milk Production by Seasons

Seasonal fluctuation of the production of milk was tremendously great on a large majority of the farms. This variation in the amount of milk produced per cow from season to season, or from winter to summer, is due primarily to the seasonality of pasture production and breeding practices as well as to feeding practices. Since few farmers grow winter pastures and with many feeding lightly in the winter, milk production is piled up from April to September. In fact, 64 percent of the milk produced by 571 cows on 40 farms was produced from April to September, or in just 50 percent of the year. Figure 2 shows the monthly trend of total milk sold on the 40 farms as well as the trend for the monthly butterfat test.

This great fluctuation in milk production during the year affects very little the efficient operation of the farm business as they are now organized, since the labor spent on a cow varies only a small amount from season to season. On the other hand, milk processing plants are faced with a very difficult problem. Since their equipment, which represents a relatively large investment, is used only for processing whole milk, these plants are forced to carry equipment and labor necessary for capacity production for less than 6 months during the year and then operate much under capacity for a large portion of the year. Should the milk plants in the area shut down during their slack season, there would be no market outlet for farmers producing milk, which would be disastrous to the dairy business. Yet most dairy farmers permit their cows to virtually shut down in production during the winter months and expect milk plants running at one-fourth capacity or less to continue operation.

Seasonal production related to costs and returns. Thirteen farms milked cows that produced for sale during the months of January, February, and March, only 146 pounds each per month. (See table 38.) That was less than ½ gallon daily per cow. For the 40 farms as a whole, the average daily amount sold per cow in the months of January, February, and March was only 7.3 pounds of milk. That was less than 1 gallon per day. Cows producing above 5,000 pounds for sale during the year averaged 11.6 pounds of milk per day in the first quarter of the year and reached a production of slightly less than 2 gallons per day in the months of July, August, and September

Table 38. Pounds of milk sold monthly per cow in each quarter of year and costs and labor returns for 571 cows on 40 farms in Northeast Mississippi, 1944

Pounds of milk sold per cow	No. of cows	No. of farms	Pounds sold monthly per cow				Cost per 100 lbs. milk	Labor returns per hr. on cows
			January-March	April-June	July-September	October-December		
Below 3,000	198	13	146	276	262	151	$3.88	$0.25
3,000 - 3,999	227	18	203	410	380	181	2.99	0.56
4,000 - 4,999	112	7	341	461	430	272	3.41	0.58
5,000 - 5,999	34	2	350	471	485	392	2.99	0.64
Total	571	40	219	377	355	201	2.83	0.42

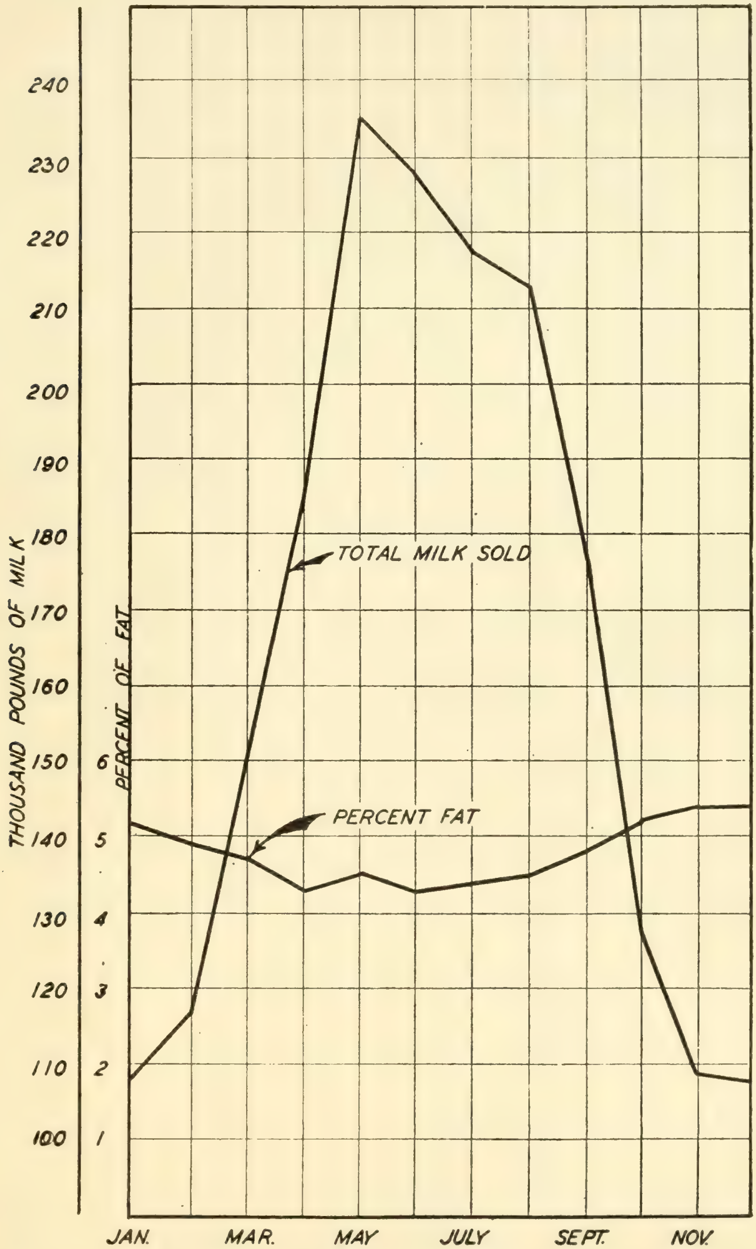

Figure 2. Total milk sold and butterfat test by months for 571 cows on 40 farms in Northeast Mississippi, 1944.

—their highest producing quarter. Milk sold per cow, on the average, was 1.3 pounds per day less than was produced. This amount was consumed by the family or by calves. Cows producing less than 5,000 pounds of milk sold per year reached their peak of daily production in the second quarter of the year.

Figure 3 shows the trend of milk sold monthly per cow in each of the quarters of the year, as well as the labor return per hour for labor used on milk cows. Increase in production for the second quarter of the year was rather abrupt. The increase for cows producing below 3,000 pounds sold annually was approximately 90 percent, and over 100 percent for cows producing from 3 to 4 thousand pounds. This increase in the springtime was not as great for cows above the 4,000-pound mark. It is shown further that production per cow declined gradually from the second quarter to the third quarter, except when more than 5,000 pounds were sold per cow, and then dropped precipitously in the fourth quarter, reversing the movement in the spring months.

Figure 2 shows the monthly trend of total milk sold on the 40 farms as well as the trend for the monthly percent butterfat test. This monthly trend of milk sold coincides closely with pasture conditions. It should be noticed that cows producing from 340 to 350 pounds of salable milk monthly in January, February, and March, which is approximately 1.3 gallons per day, gave a labor return of more than twice as much per hour as was given by cows producing an average of 146 pounds per month.

Cows producing below 3,000 pounds of market milk per year and dropping very low in winter production, produced milk at a cost of $3.88 per 100 pounds with a labor return of $0.25 per hour. Cows producing from 4,000 to 5,000 pounds of market milk annually produced it at a cost of $3.41 per 100 pounds and gave a labor return of $0.58 cents per hour.

Farm Practices

Practices followed by farmers in operating their businesses are very important in the effect upon costs and income and the profitableness of the farm as a whole. Farmers often follow different practices and get practically the same results. If the results are good, then both practices may be good under the given conditions. However, if farmers are using poor practices, results obtained very seldom give pleasure and profit in the business.

Practices followed in feeding cows varied from farm to farm giving varying results. Records of these methods of feeding show that the combination of feeds and the capacity of cows to convert feed materials into milk play a greater part in profitable milk production than do mere quantities of feed. A few farmers feed for winter production and may feed to keep their cows alive until spring grass comes. Others feed for winter production and then practically quit feeding when the cows begin to get a few nibbles of grass in the spring. A few dairymen are beginning to provide winter grazing by planting oats, or other winter crops. All indications point to the need for a more detailed study of feeding practices by dairymen under actual farm conditions.

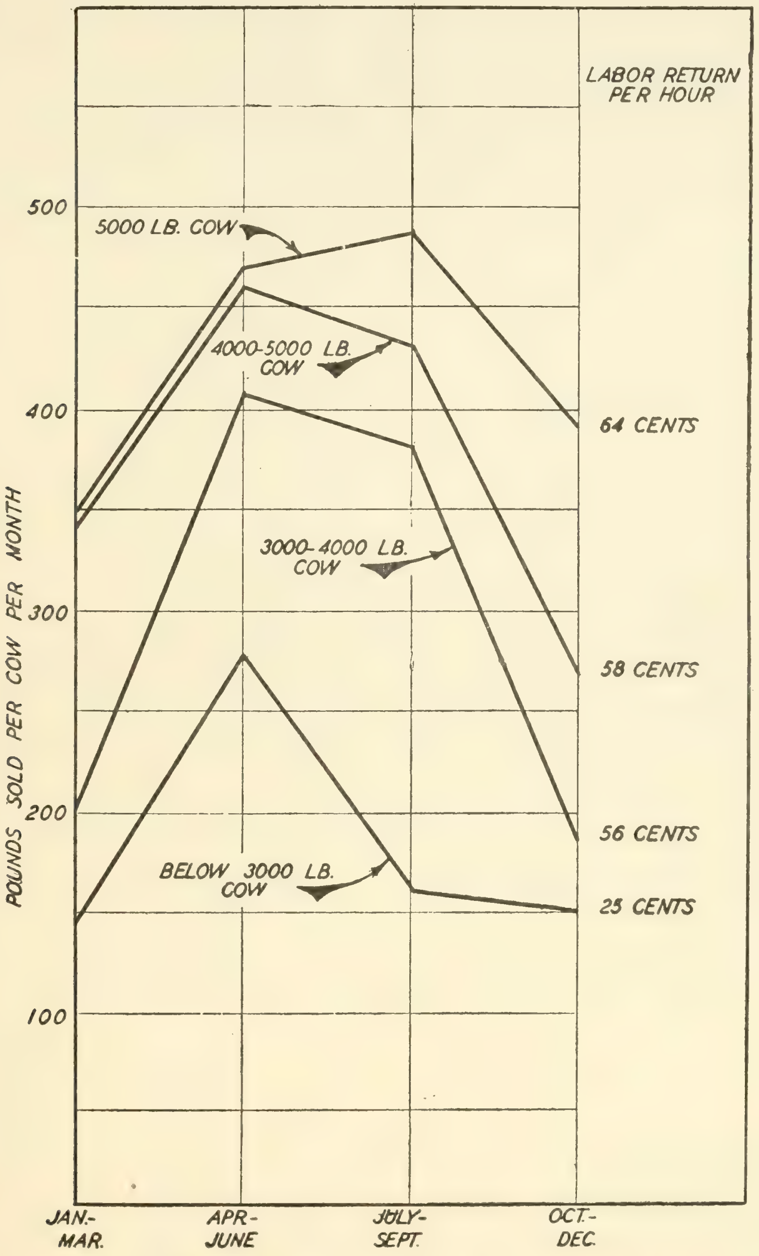

Figure 3. Pounds of milk sold monthly per cow in each quarter of year and labor return per hour spent on cows producing different amounts of milk on 40 farms in Northeast Mississippi, 1944.

Producing milk for the winter market. Farmers milking cows that have a relatively high production in the winter when compared with those having a low production in the winter months, produce milk more cheaply and receive the largest return per cow. Line graphs of monthly production per cow when production was low and when relatively high in winter months are shown in figure 4.

Low winter producers had an average production of only 121 pounds in January, or 4 pounds per day. Their production was 165 and 158 pounds, respectively, for November and December, and 160 pounds for February. Their peak production of 425 pounds per month was reached in May. Production for low winter producers almost doubled in the 2-month period of September and October.

When winter production was relatively high, the average production per cow for January was 392 pounds, or 13 pounds per day. Low winter producers gave less than ½ gallon of milk per day, which indicates that the low producers were practically dry.

The yearly per day cost of keeping the average cow on the five farms where production of milk was low in winter months was $0.29. The yearly per day market value of the milk produced on these same farms was 3.72 cents per pound. With a cow producing 4 pounds per day, the daily value of milk per cow was 14.88 cents. Thus the average cow on the five farms where winter production was low was kept at a loss of about 15 cents per day during January. The loss per day would have been greater if the daily cost had been determined for the month of January. This unfavorable situation continued through February and on into the spring months until production increased sufficiently to equal cost of production. In the fall months, production dropped to the point where daily costs per cow for the months of October, November, and December were greater than the daily value of milk produced.

On the other hand, the yearly per day cost to keep the average cow on the five farms where production of milk was relatively high per cow in the winter months was 39.7 cents. The yearly per day market value of the milk produced on those same farms was 3.85 cents per pound, and with a cow producing 13 pounds of milk per day in January, the daily value of milk produced was 50.1 cents. Therefore, the average cow on the five farms where winter milk production

Table 39. Rate of production in winter related to feed, labor, cost, and profit

Item	Low winter production per cow	Relatively high winter production per cow
Cows per herd	14	12
Production per cow, lbs.	3,227	4,960
Concentrates per cow, lbs.	865	1,543
Roughage per cow, lbs.	2,335	2,039
Man hrs. per cow, hrs.	163	123
Feed and pasture costs per cow, dollars	53	77
Cost of cow per year, dollars	112	144
Profit per cow, dollars	16	54
Labor return per hour, cents	35	72
Cost per 100 lbs. milk, dollars	3.29	2.76

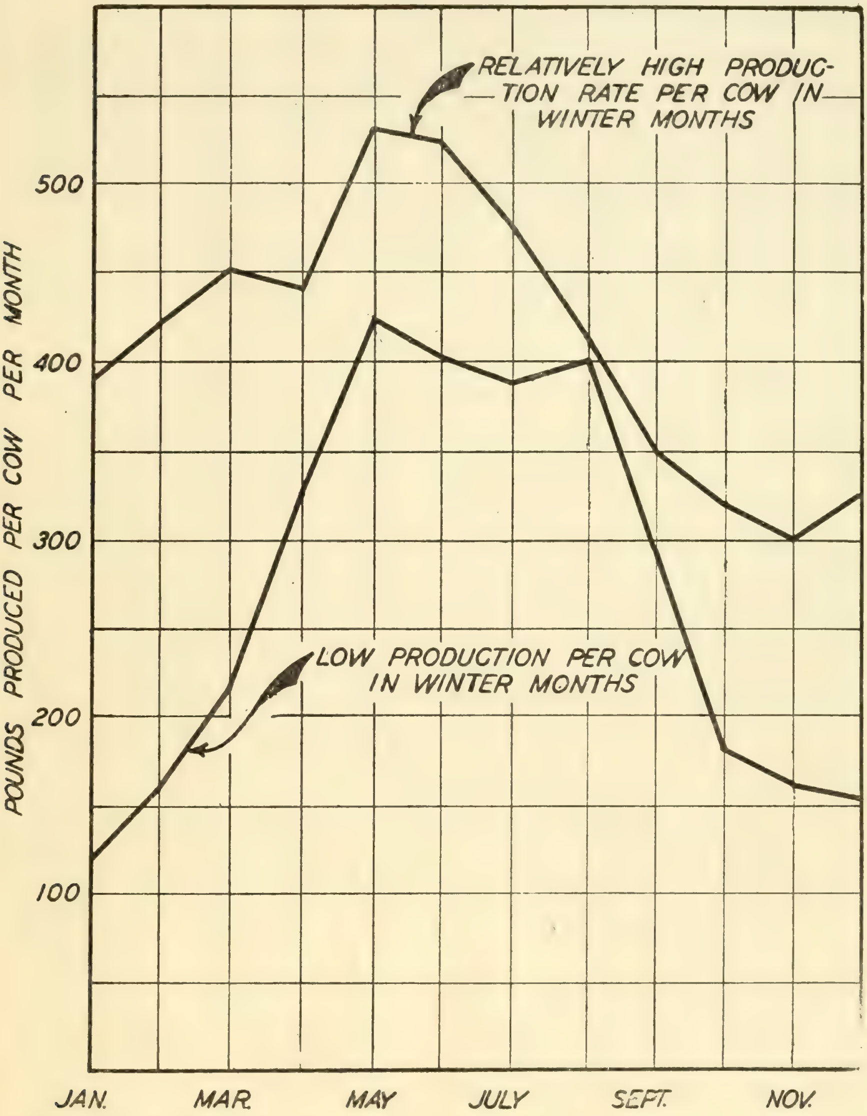

Figure 4. Five farms with very low winter milk production per cow, and five farms with relatively high winter production per cow related to various factors, 1944.

Milk production per month for 571 cows increased 117 percent from January to May and decreased 50 per cent from July to November. This fluctuation in milk makes it very difficult for milk plants to operate efficiently throughout the year. Also, it creates a problem for milk truckmen. Since more winter production usually results in higher profit per cow, farmers need to consider more seriously the problem of seasonal production.

was relatively high was kept at a gain of 10.4 cents per day. This gain was above all costs including labor.

On farms where winter production per cow was low, the amount of milk produced per cow during the year was 1,733 pounds less than the amount produced by cows relatively high in winter production. (Figure 3.) Concentrates fed per cow were considerably less on the low-winter production farms. They did feed, however, a little more roughage per cow than was fed on high winter production farms. Profit per cow was three times greater and labor returns per hour used on cows was twice as great on farms where winter production per cow was relatively high. Also, the cost to produce 100 pounds of milk was 53 cents less on those farms. The foregoing shows that it was much more profitable to keep cows producing relatively high in the winter months as well as during summer.

Cotton production with and without sharecroppers. Thirty-two of the 40 farms on which records were kept produced cotton. Eight of these farms did not have sharecroppers. The work was done by the operator and members of the family, by swapping labor with neighbors, and by hiring a small amount of cash labor in rush periods.

Farms with sharecroppers produced nearly four times as many acres of cotton as were produced by farms without sharecroppers. (See table 40.) The cost to produce one acre of cotton was greater where sharecroppers were used, but this was due principally to the high cost of labor which was paid with one-half of the cotton crop and to less efficient use of this labor on the larger farms. 1944 was a very favorable year for producing cotton in Northeast Mississippi, and the half of the cotton crop going to the tenant as payment for his labor explains to a large extent the difference in cost per acre. Labor on farms without croppers was valued at the current rate paid labor without lodging and meals.

Table 40. Farms with sharecroppers and farms without sharecroppers related to various factors, Northeast Mississippi, 1944

Factors	Eight farms with sharecroppers	Eight farms without sharecroppers
Acres of cotton per farm	31	8
Lint cotton per acre, lbs.	569	459
Cost per acre, dollars	94	64
Cost per pound of lint, cents	13.06	10.67
Profit per acre, dollars	50	51
Man hours per acre of cotton, hours	162	131
Man hours cost per pound, lint, cents	8.34	5.66
Labor return per hour on cotton, cents	71	67
Soil fertility	High to medium	Medium
Crop adaptation	Good	Good to fair
Labor income* dollars	$2,021	$1,019

*It should be kept in mind that all of these farms produced milk for the market.

Labor returns per hour spent on cotton for sharecropper farms were slightly above the labor returns on farms where there were no sharecroppers. The larger yield on farms with sharecroppers contributed to this difference. Farms with sharecroppers had soils with higher fertility and better soil-crop adaptation, all of which was a contributing factor affecting labor returns.

Summary

This study was based on farm records kept by 40 farmers in 5 counties of Northeast Mississippi for the year 1944. Farms were selected in the Black Prairie, Northeast Highland, and Pontotoc Ridge soil areas, and were further selected on the basis of emphasis placed on milk cows and cotton.

The average acreage per farm was 170 with cropland amounting to 44 percent. Open, tillable pasture amounted to 25 percent of all land, and open non-tillable land represented 12 percent.

Milk cows were the most numerous livestock on the average farm with 14 head each. The range in number was from 4 to 40.

The average investment per farm was $10,743. Total real estate investment amounted to $38 per acre and livestock, equipment, feeds, and miscellaneous supplies amounted to $25.20, which gave a total farm investment of $63.20 per acre. Average farm receipts amounted to $5,930; farm expenses were $3,973, and the average labor income was $1,420 per farm.

Milk was produced for sale on all farms. There was an average of 14 milk cows per farm with an annual production each of 3,931 pounds. The feed cost was 59.6 percent of the total cost of producing 100 pounds of milk. Man labor amounted to 27.3 percent. The net farm cost to keep a cow for one year was $120.98, and the net farm cost to produce 100 pounds of milk was $3.08. With an average hauling charge of 25 cents per 100 pounds, the cost of 100 pounds delivered at the plant was $3.33.

The cost of producing milk delivered at the plant on dairy-cotton, cotton-dairy, and dairy & cotton farms was $3.27, $4.09, and $2.83, respectively. Similarly the profit per cow was $36, —$7, and $42. The average cost to keep a cow for 1 year on dairy-cotton farms was $120; on cotton-dairy farms, $130; and $113 on dairy & cotton farms. (Price received at plant.) It will be noticed that costs were least and labor returns were highest on dairy & cotton farms.

Thirty-two farms produced cotton averaging 21.8 acres and 20.2 bales ginned per farm. The average price received per pound of lint cotton was 21.21 cents, and the cost to produce one pound of lint was 13.28 cents. Man labor constituted 60.5 percent of the total cost to produce 1 pound of lint. An average of 141 hours of man labor was required on the 32 farms to grow 1 acre of cotton. On dairy-cotton farms, 112 hours of man labor were required to produce 1 acre of cotton. On cotton-dairy farms, 151 hours were required, and dairy & cotton farms required 120 hours. The cost to produce a pound of lint cotton on dairy-cotton, cotton-dairy, and dairy & cotton farms was 13.31 cents, 13.55 cents, and 12.42 cents, respectively.

The cost to produce a bushel of corn was 95.5 cents; 100 pounds of live pork, $12.41; and the cost to keep one head of workstock for a year was $105.82.

Cotton-dairy farms had more total acres, cotton acres, crop acres, and a larger investment than the dairy-cotton or dairy & cotton farms. Farms in the Black Prairie soil area ranked highest in all measures of size of farm business. The Northeast Highland came second and the Pontotoc Ridge Area was third.

As the man work units per farm increased, the number of cows increased, acres of cotton increased, and labor income increased. Labor returns per hour of labor increased as the number of cows in the herd increased. In general, as the acres in cotton per farm increased, the man hours of labor required to produce one bale increased. This seems to be due to the fact that as the size of the farm increased, the number of sharecroppers per farm increased, which indicates that sharecropper labor was used less efficiently. Also, as the man equivalent available for work on the farms increased, the units worked per man decreased. With man labor constituting 60.5 percent of the cost of producing a pound of lint cotton, the efficient use of labor is of vital importance. Labor requirements per cow were lowest on dairy & cotton farms.

Cotton-dairy farms kept the lowest producing cows and dairy & cotton farms kept the highest producers. There was little relationship between the amount of milk produced per cow and the size of the herd. Cows producing less than 3,000 pounds of milk per year showed a loss of $15.75 per head, whereas cows producing above 5,000 pounds netted the farmers $44 each. The average annual production per cow for the 40 farms was 3,931 pounds, and production per cow on dairy & cotton farms was 4,392; on dairy-cotton farms, 3,993 pounds; and on cotton-dairy farms, 3,413 pounds. Farmers keeping cows that produced above 5,000 pounds produced the last 3,000 pounds of milk at a cost of $1.70 per hundred when compared with production per cow of less than 3,000 pounds. Labor returns per hour spent on milk cows increased as the milk produced per cow increased, and the annual labor return per cow was $85 where production averaged above 5,000 pounds.

The production of lint cotton per acre ranged from 196 pounds to 837 pounds. Seventy-five percent of the farms producing cotton had an average yield of about 400 pounds per acre, and 44 percent had a production above 500 pounds per acre. All types of farming showed an increase in man hours required per acre, total costs per acre, and profit per acre as the pounds of cotton produced per acre increased. The yield was slightly more than a bale per acre on both cotton-dairy and dairy & cotton, and only 2/3 bale per acre on dairy-cotton farms.

The principal combination of farm enterprises on farms was cotton, milk cows, corn and hay. Cotton and milk cows were the major income enterprises. Farms placing major emphasis on cotton lost $7 per milk cow, but made a profit of $38 per acre on cotton. Farms placing about the same emphasis on both cotton and milk cows received the greatest return per cow and per acre of cotton. Farms producing milk at the highest cost produced twice the acreage of cotton that was produced on low cost farms. Variations in the proportionate combinations of enterprises on farms producing cotton and milk at a high cost and a low cost (table 33) was not significant, except for the difference in cotton acreage, which would indicate that differences in costs were due more to such factors as capacity of cows, feeding practices, pasture per cow, quality of seed, amount of fertilizer used, soil fertility, labor efficiency and the managerial ability of the farmer.

The cost to produce one pound of cotton increased as soil fertility decreased. The cost relationship was the same for each of the soil areas.

The rate of crop production was highest where soil-crop adaptation was good. The cost of producing cotton per pound was 23 percent greater on farms with poor soil-crop adaptation than on farms where soil-crop adaptation was good. It cost 50 percent more to produce corn on farms where the soil-crop adaptation was poor than where it was good; and labor income was highest on farms where soil-crop adaptation was good, and lowest on farms with poor soil-crop adaptation.

Sixty-four percent of the milk produced by 571 cows on 40 farms was produced from April to September, inclusive, or in one-half of the year. The daily average amount of milk sold per cow in the months of January, February, and March was 7.3 pounds, or less than 1 gallon. Milk production per month for the 571 cows increased 117 percent from January to May, and decreased 50 percent from July to November. Cows producing below 3,000 pounds of market milk per year, and dropping very low in winter production, produced milk at a cost of $3.88 per 100 pounds with a labor return of 25 cents per hour. Cows producing from 4,000 to 5,000 pounds of market milk annually produced at a cost of $3.41 per 100 pounds and gave a labor return of $0.58 per hour.

On five farms where milk production was lowest per cow in January, the average amount produced daily by each cow was 4 pounds—less than ½ gallon. These same cows reached their peak production of 14 pounds of milk per day or 1.6 gallons in May. On five farms where winter production was relatively high, the average daily production per cow in January was 13 pounds. Low winter producers were kept at a loss of 15 cents per day in January, and relatively high winter producing cows were kept at a gain of 10.4 cents per day. Profit per cow was three times as great and labor returns per hour were twice as great, on farms where winter production per cow was relatively high.

The cost to produce one acre of cotton was greater where sharecroppers were used, but this was due principally to the high cost of labor which was paid with one-half of the cotton crop and to less efficient use of this labor available on the larger farms.

Recommendations

In summary, the findings of this study appear to suggest the following recommendations:

Keep high producing cows. Cows with a production below 3,000 pounds gave an annual labor return of $14. On farms where production was above 5,000 pounds, the return was $85 per cow.

Grow cotton on soils of high fertility. The cost to produce cotton on farms of high soil fertility was 12.58 cents per pound, whereas the cost was 14.67 cents on farms of low soil fertility, or a cost spread of nearly 2 cents. This spread of cost between high and low fertility farms was nearly 4 cents per pound in the Black Prairie area. On land that produced between 700 and 800 pounds of lint per acre, the profit on each acre was $83. On land that produced between 200 and 300 pounds of lint, the profit per acre was only $15.

Use labor more efficiently. Cows on which 125 hours were spent gave a labor return of $0.56 per hour, and cows on which more than 200 hours were spent gave a labor return of only $0.18 per hour.

The average cost to grow a pound of lint was 13.28 cents. Labor amounted to 8.04 cents of this cost, or 60.5 percent of the total cost to produce a pound of lint cotton. On farms where the average labor performed per man available was less than 100 days during the year, the man labor cost to produce 1 pound of lint cotton was 9.3 cents. Where the days of labor per man were 250 and above, the man labor cost was 5.2 cents per pound.

Place major emphasis on both cotton and dairy enterprises. There is a definite place for both cotton and milk cows in the organization of farms in Northeast Mississippi. This combination of enterprises permits more efficient use of labor and farm by-products, and cotton and dairy cows supplement each other by giving the farmer a higher return per hour for his labor.

Labor return per hour spent on milk cows on dairy & cotton farms was $0.61. On dairy-cotton farms the returns were $0.47 per hour and on cotton-dairy farms it was only $0.22 per hour. On dairy & cotton farms labor returns per hour spent on cotton was $0.81, whereas it was $0.49 and $0.61, respectively, on dairy-cotton and cotton-dairy farms.

Grow crops on soils to which they are best adapted. On farms where soil-crop adaptation was good, the cost to produce a pound of cotton was 12.42 cents, and the cost to produce a bushel of corn was $0.94. Where soil-crop adaptation was poor, the cost was 15.17 cents per pound for cotton and $1.41 per bushel of corn.

Feed cows for winter production. Low winter producers gave a labor return of $0.35 per hour. Relatively high winter producers returned $0.72 per hour.

Breed for winter production. Cows bred to calve in the late fall are available for their best flow of milk in the winter months as well as in the spring and early summer months.

Reduce costs by increasing rates of production. Farms that produced cotton at the lowest cost had the highest yields, or 1.14 five-hundred pound bales per acre, and farms producing cotton at the highest cost had the lowest yields or 0.78 five-hundred pound bale per acre.

Cows producing less than 3,000 pounds of milk annually, produced it at a cost of $4.51 per 100 pounds, and cows producing more than 5,000 pounds produced it at a cost of $3.11 per 100 pounds, or a difference of $1.40.

Large farms should use available labor more fully. Days of work (10-hour days) per man on farms with more than three man equivalents available averaged less than 125 for the year. Days of work per man on farms with 1.6 man equivalents available averaged 310.

Keep only workstock needed. The net cost to keep one head of workstock for a year was $106.

Use workstock more efficiently. The average head of workstock was used only 46 ten-hour days during the year.

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Some Factors Related To Food Preparation

By

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Some Factors Related to Food Preparation

By **DOROTHY DICKINS**
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It is the purpose of this report to examine some of the factors probably related to family food preparation—factors such as family composition, schooling, and food and nutrition information of homemaker, economic status of family, family background of homemaker and male head, time expenditures in food preparation, scheduling of homemaker, type of menus served, equipment for food preparation, and arrangement of this equipment. It is important to learn more about these factors and how they are related to food preparation, for it is on the basis of such information that practical suggestions for improving preparation can be formulated. Better food preparation is one way of raising the level of living of a family. The food supply one has can be made more adequate by following the methods of preparation that conserve nutrients. A more adequate food supply will result in better health and better health in higher levels of living.

Scope of Study

This is part of a large study of food preparation of small town families of Mississippi. It includes 160 of the 1,158 families in the larger study,[1] selected so that there were 16 or more families in each of eight groups: white families in the Delta and Shortleaf Pine Area towns with housing values of $20.00 and under, and of $20.01 to $40.00; and Negro families in the Delta and Shortleaf Pine Area towns with housing values of $7.50 and under, and of $7.51 to $20.00. (By housing value is meant monthly rent or rental value of house or apartment unfurnished in which the family resides.)[2] Families with housing values of more than $40.00 were not included in this study, since there were too few of the 1,158 families to secure a large enough record sample.

Data were obtained in the summer of 1943 from records kept by homemakers and from schedules filled out by means of personal interviews with these women. White and Negro home economists supervised record keeping and secured other information by interviewing the homemaker.[3]

The homemakers were asked to keep a record of methods used in preparing 12 foods served in the home during one week. (See Appendix for record forms used.) The foods for which the records were kept were limited to: (1) cooked vegetables, (2) meat, fish, poultry, or eggs, (3) breads, and (4) vegetable salads. The homemaker was asked to limit records of any one food, such as cornbread, string beans, to 3, unless variety of foods served in this period was so limited that more than 3 records of a food must be kept to yield 12 preparation records. It was asked that records be kept of those foods ordinarily served when the food was in season and suggested that a good distribution would be six cooked vegetables, one vegetable salad (if served that often), and remaining five—breads, eggs, meat, fish, and poultry—as the homemaker preferred. It was requested that no changes in methods of preparation be made during the study. Measuring cups, spoons, and scales were furnished.

Other records kept by the homemaker during the week of the study were of her own activities during each day, of assistance in homemaking activities,[4] and of all foods served during this period. The supervisor obtained information from families in which records were kept concerning kind and condition of equipment for food preparation and concerning kitchen arrangement. She also secured information pertaining to family history of homemaker and male head that might throw some light on the food preparation pattern of the family. Data concerning family composition, schooling, food and nutrition education, and economic status were secured in the initial study from which these families were selected.

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[1] See "Changing Pattern of Food Preparation of Small Town Families in Mississippi," Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. 415, p. 3.

[2] Ibid., p. 8.

[3] Record keeping in 5 of the 80 white families was supervised by a home economics club leader.

How Representative Are the Families

In the larger study, one or two general questions concerning the usual methods of preparation and/or serving 12 common foods had been obtained from each of the families. When the information obtained from the larger group and from the record keeping group of the same race and housing value are compared, somewhat better practices concerning preparation and/or serving were found on the part of the record sample than of the entire group. This was much more true of Negro families than of white families. Keeping records, even when one has the help of a supervisor, is too difficult for women of little schooling and thus cooperation of the near-illiterate is definitely limited. Median school grade completed by Negro homemakers in the larger study was the sixth, by record keeping Negro homemakers in this study, the eighth. Median grade completed by white homemakers in both groups was the twelfth.

Also, it may be that there is more interest in keeping food preparation records on the part of those who have better practices. The fact that record keepers with the same schooling as non-record keepers reported, for example, somewhat greater use of milk and eggs in cooking, more enriched flour, less draining of canned beans, would indicate that record keeping may select those with somewhat better practices.

Records of Food Preparation

The 160 white and Negro homemakers in this study kept records of 1,857 of the dishes they served during the record week. The average number of preparation records kept of the different types of food per family (i.e., vegetables, meat and eggs, breads, vegetable salads) is given in table 1. As will be noted, white homemakers kept more records of vegetables and of vegetable salads; Negro homemakers more of meat and eggs and of breads. Vegetables and vegetable salads were more frequently served during the record week in homes of white families; breads in homes of Negro families (table a in Appendix). Greater frequency of preparation would, therefore. account for more records being kept. The reason that Negroes kept more records of meat and egg dishes, when fewer of these dishes were prepared than in case of whites (table a in Appendix), may be that they wanted to cooperate by furnishing 12 records, yet variety of foods prepared was limited. Therefore, they had to keep more meat and egg preparation records. They preferred doing this to turning in a number of records of cornbread and biscuit preparation, though they were free to do so.

Preparation records of sliced tomatoes served to the family during the record week are included under vegetable salads, since the number of vegetable salads prepared in these 160 families during the study week was small (table a in Appendix). Sliced tomatoes are not a vegetable salad, but since they were frequently used and since their preparation, it was thought, would be indicative of the way the family would prepare salad, it

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[4] For a complete report on time expenditures in homemaking activities of these families, see "Time Activities in Homemaking," Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 424, Oct. 1945.

Table 1. Total number of food preparation records and average number of records per family kept by white and Negro homemakers classified by food type and housing value.

Food type	White families				Negro families			
	Housing value $20 and under		Housing value $20.01-$40.00		Housing value $7.50 and under		Housing value $7.51-$20.00	
	No. records	Av. per family	No. records	Av. per family	No. records	Av. per family	No. records	Av. per family
Vegetables	245	6.0	217	5.6	200	5.1	218	5.3
Meat and eggs	96	2.3	129	3.1	141	3.6	154	3.8
Breads	68	1.7	66	1.7	87	2.2	91	2.2
Vegetable salads*	48	1.2	42	1.2	22	.6	33	.8
Total	457	11.2	454	11.6	450	11.5	496	12.1
Number of families	41		39		39		41	

*Including sliced tomatoes. See table a in Appendix.

Table 2. Average number of poor preparation practices per type of food for which records were kept by race and housing value of family.

Food type	White families		Negro families	
	Housing value $20.00 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
	No. poor practices per record	No. poor practices per record	No. poor practices per record	No. poor practices per record
Vegetables	2.4	1.9	2.6	2.4
Meat and eggs	.3	.2	.4	.3
Breads	.2	.3	.2	.3
Vegetable salads	.3	.3	.4	.5
Number of families	41	39	39	41

was decided to accept records for preparing sliced tomatoes.

Table b in the Appendix gives a complete list of foods for which preparation records were kept. Records of preparation of Irish potatoes, field peas (common name for cowpeas), butter beans (common name for small lima beans), string beans, corn, and okra were the vegetables records most often submitted. All these vegetables were in season at the time of the study. More families kept records of cornbread preparation than of biscuit preparation. More Negro women submitted records of pork dishes; more white women of egg dishes. A number of both groups kept records of preparation of chicken, usually fried chicken. Chicken of frying size was in season at the time of the study.

Poor Preparation Practices

Poor preparation practices are practices that are contrary to recommendations of food and nutrition specialists. Some homemakers in preparing a particular dish followed four or even more practices contrary to recommendations of specialists, while others observed in every detail recommendations of specialists. Table 2 gives the average number of poor preparation practices by food type for the four groups of families.

As will be noted, there were many more poor practices in connection with preparation of cooked vegetables than with the preparation of meat and eggs, with breads, and with vegetable salads. This was because vegetables contain vitamins very easily destroyed by poor methods of cooking and storage. There has been more research on losses in cooking vegetables than in the case of foods of other types and, therefore, more possibility for vegetable practices receiving a poor rating. Then, again, in vegetable cooking we

Table 3. Poor preparation practices used by white and Negro families in cooking vegetables.

Poor preparation practices	White families Housing value $20.00 and under	White families Housing value $20.01-$40.00	Negro families Housing value $7.50 and under	Negro families Housing value $7.51-$20.00
	Percent of vegetable records kept using practice			
Starting vegetables in cold water	63.7	52.5	50.5	55.1
Excessive cooking	43.3	36.9	62.0	47.7
Poor storage between cooking and serving	64.5	49.8	69.0	67.0
Poor storage between harvesting or purchasing and cooking	26.1	9.7	8.0	5.5
Poor storage between serving at first and second meal	30.0	21.2	18.0	22.9
Soaking in water after preparation for cooking	6.1	2.8	16.0	16.5
Parboiling	4.1	3.7	10.5	7.8
Soda to tender	*	*	7.5	6.9
Washing in soda water	0	0	11.0	5.1
All other poor practices	8.6	16.1	9.5	8.7
Number of vegetable preparation records	245	217	200	218

*Less than 0.5 percent.

have the problem of the cooking water which is sometimes drained off during cooking or after cooking is complete.

In table 3 are listed kinds of poor practices found in the 880 records kept of vegetables. Most frequent poor practices by white and Negro women were starting vegetables in cold water, excessive cooking, and poor storage between cooking and serving.

The frequency of starting vegetables in cold water was probably related in part to the kind of vegetables used. Records of preparation of butter beans, field peas, Irish potatoes, and corn constituted somewhat more than 50 percent of the vegetable records. In a previous study it was shown that some homemakers had been taught by their mothers or someone in the parental homes, preparation rules such as: "Put all vegetables except leafy vegetables on in cold water." "Starting beans and peas in cold water makes more tender."[5] Evidently, a number of homemakers were following preparation rules learned from mother. Nutritionists advise starting vegetables in boiling water to reduce cooking time and destroy oxidases quickly.

Since time of cooking varies with kind of vegetable, with maturity of vegetable, with quantity cooked, with size and kind of cooking utensil, it was often difficult to draw a dividing line between overcooked and properly cooked vegetables. Vegetables classified as "excessive cooking" are those which were without doubt cooked too much. In making this classification, the time table for boiling vegetables given in "Hows and Whys of Cooking," by Halliday and Noble, was consulted.[6]

The practice of allowing a sufficiently cooked vegetable to remain in the warmer, in the oven, or on the back of the stove until served was regarded as poor storage between cooking and serving. Vegetables were cooked oftentimes in the middle of the morning and kept warm after cooking until dinner time when they were served. This practice was classified as poor storage between cooking and serving. Keeping vegetables warm until served was not considered a poor practice when total time of cooking and of keeping warm did not exceed time regarded as excessive cooking.

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[5] Traditional Food Preparation Rules, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 418.

[6] Hows and Whys of Cooking, E. G. Halliday and I. T. Noble, Univ. of Chicago Press, p. 24, 1941.

The practice of cooking foods in the early morning to be served at noon is said to have come originally from desire to reduce to the minimum heat from cooking in the house. In farm homes in which most of these homemakers were reared, wood was used as fuel and continued heat in the kitchen is especially enervating in warm weather.

Fifty-one of the 80 white families and one of the 80 Negro families had gas. electric, or oil cookstoves. Seventy-one percent of the vegetable dishes in white families and 68 percent in Negro families with wood and/or coal cookstoves only, were poorly stored from time between cooking and serving. Forty-six percent of the vegetable dishes, in white families with gas, electric, or oil cookstoves, were poorly stored between cooking and serving. It would thus seem that the poor practice is not entirely due to absence of an electric, gas, or oil cookstove. It may be that practices have been held over from parental homes where wood cookstoves were used. Work schedules as well as methods of preparation may be handed down from mother to daughter.

Storage of vegetables indoors, usually in the kitchen (not refrigerated) overnight before using and/or preparing vegetables for cooking the afternoon or night before were classified as poor storage between harvesting and cooking. Twenty-six percent of the vegetable records kept by homemakers in white families of $20.00 and under housing value, used poor storage between harvesting or purchasing and cooking. About 8 percent of the vegetable records kept by homemakers in the other three groups had this poor practice. Homemakers in white families of $20.00 and under housing value were particularly prone to harvest vegetables the afternoon of the day before using and to prepare them then. Shelling butter beans and field peas ahead was fairly common. Research studies show that beans and peas stored in pods lose less vitamin C than if stored shelled.

An important factor no doubt responsible for homemakers in white families of $20.00 and under housing, shelling peas and beans ahead of time more frequently than homemakers in other groups was that they had more young children. Preparing vegetables ahead was perhaps one means of distributing their work load. They spent, during the record week, an average of 69 hours in homemaking activities. Total time spent by homemakers in the higher housing value white group averaged 63 hours, and by Negro homemakers in both housing value groups, 60 hours.[7] Homemakers need a list of food activities that can best be done in advance.

There were three general types of supper meals served by families of this study during the study period: (1) left-overs from dinner, (2) sandwiches, (3) a meal somewhat resembling breakfast. The first was the most common. It was more common among white families than among Negro families. It was more common in white families of low housing than of high housing value. Vegetables left from dinner were usually eaten without being reheated. Sometimes these vegetables were stored in safes (a movable stand with shelves, closed back and sides, and screened doors in front, used for keeping provisions from insects), in the oven, or in the warmer, in the interval between dinner and supper. No relation was found in ownership of a refrigerator, or in type of refrigerator, and storage of vegetables between meals. However, all white families, except one, owned either an ice or a mechanical refrigerator. Only 12 Negro families did not have a refrigerator of either kind. These 12 families kept few vegetables from one meal to the next. In fact, some of them served no supper meal at all.

The practice of storing left-over vegetables on stoves or in safes has no doubt been carried over from the time when there were no refrigerators. The factor responsible for continuation of this practice on the part of some is preference for vegetables such as those that remain at room temperature. The fat hardens on refrigerated vegetables and this is unpalatable. Then, too, space in refrigerators is often quite limited. Homemakers need instruction concerning foods that can best be left out of the refrigerator.

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[7] Time Activities in Homemaking, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 424, 1945.

As will be noted, the practice of using soda in preparation of vegetables was almost altogether limited to Negro families (table 3). Recent studies have shown that the use of soda is not destructive of vitamins when only a small amount is used and the vegetable cooked until tender and no longer, and served soon after. However, families in this study using soda cooked the vegetable excessively and/or allowed it to stand on a stove for some time before serving.

It is interesting here to note that even though a number of homemakers used poor practices in vegetable preparation, most vegetables were eaten and liked by family members. All family members were reported as having eaten 95 percent of the vegetable dishes for which records were kept. However, record keeping was limited to those vegetable dishes ordinarily served when the vegetable was in season.

Poor practices in meat and egg preparation were in most cases frying meat and eggs in smoking grease, or boiling rather than simmering eggs. Other poor practices included cooking chicken in water in which soda had been added in order to make tender, soaking young chicken in soda water, soaking liver in boiling water before cooking to draw out the blood.

Poor practices in bread preparation included, for the most part, using more soda than the recommended amount, one-half teaspoonful to a cup of sour milk. (This amount would vary with acidity of the milk and for this reason some of the bread records may have been incorrectly rated.) Several white homemakers prepared rolls with yeast, soda and baking powder. The use of such a recipe was regarded as a poor practice, since no sour milk was used to neutralize the soda, and since sufficient yeast had been added to make rolls light. Use of excess soda gives a yellow color and a disagreeable flavor. In addition, an alkaline reaction favors the destruction of thiamin by heat.

The most common poor practice in connection with preparation of sliced tomatoes was slicing sometime before the meal and placing on the dining table where they would be eaten later. Other poor preparation practices in salad preparation included grinding cabbage for slaw; peeling, cutting into small pieces, boiling, then draining potatoes for potato salad; cutting up fine all vegetables and allowing to stand in water before drained and made into salad.

Food Preparation Rated

Poor practices found in preparation records of each homemaker were checked, totaled, and divided by number of food preparation records kept. Families were then classified into three groups. (1) **Good preparation.** Less than 1 poor practice per dish; (2) **Fair preparation.** From 1 to 1.5 poor practices per dish; (3) **Poor preparation.** More than 1.5 poor practices per dish. This classification has two main weaknesses: (1) All poor practices are not equally poor; (2) Families in which more vegetable records were kept were more likely to have a lower preparation rating than other families. One might say in answer to these two criticisms that very poor practices and many poor practices seemed to be related and that most families kept about the same number of vegetable preparation records.

The method of classifying families according to number of poor practices per dish prepared for which a record was

Table 4. Food preparation ratings of families with pre-school and/or school children and with no pre-school and/or school children.

Food preparation rating	White families		Negro families	
	With children	With no children	With children	With no children
	Percent	Percent	Percent	Percent
Good	32	33	27	21
Fair	36	30	46	48
Poor	32	37	27	31
Total	100	100	100	100
Number of families	53	27	51	29

Table 5. Food preparation ratings of families and age of homemaker.

Food preparation rating	White families		Negro families	
	Homemaker under 45 years	Homemaker 45 to 60	Homemaker under 45 years	Homemaker 45 to 60
	Percent	Percent	Percent	Percent
Good	39	19	27	20
Fair	28	44	51	40
Poor	33	37	22	40
Total	100	100	100	100
Number of families*	57	16	63	15

*Seven white homemakers and two Negro homemakers were 60 years or over.

kept, will be used in this bulletin. No detailed information concerning methods of preparing particular dishes or foods will be given here. These data will be combined with preparation data obtained by the schedule method from several hundred other families and included in another report.

Twenty-nine percent of the 160 families were rated as having good preparation, 40 percent as fair preparation, and 31 percent as poor preparation when classified by the method described above.

Family Composition and Food Preparation Rating

As will be noted from table 4, there was a tendency for families with preschool and school children to have somewhat better food preparation ratings. In this study, homemakers in families with children were younger than homemakers in families without children and since younger homemakers made higher food preparation ratings than older homemakers (table 5), families with children would be expected to have higher food preparation ratings. Younger homemakers without children were not, as a rule, interested in cooperating in this record study.

In a previous study of this series[8/] a tendency on the part of older homemakers to try fewer new dishes within a stated period of time than of younger homemakers was found. Nutrition investigators are making available from day to day results of studies on conservation of food value in cooking, and hence the group who fails to change with new recommendations is the group using more poor practices.

Since smaller families of this study were more often families with older homemakers, there was a tendency, though not marked, for smaller families to have lower food preparation ratings than larger families. Thirty-six percent of the white families of two members and 39 percent of four or more members, had preparation ratings of good, while 22 percent of the Negro families of two members and 30 percent of four or more

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[8/] Changing Pattern of Food Preparation of Small Town Families in Mississippi, Dorothy Dickins, Miss. Agr. Exp. Sta. Bull. No. 415, 1945.

Table 6. Food preparation ratings of families and schooling of homemaker.

Food preparation ratings	White families			Negro families		
	Homemaker completed 10 grades or less*	Homemaker completed 11 or 12 grades	Homemaker had college training	Homemaker completed 6 grades or less	Homemaker completed 7 to 9 grades	Homemaker completed 10 grades or more
	Percent	Percent	Percent	Percent	Percent	Percent
Good	21	36	46	5	32	27
Fair	45	32	23	56	40	50
Poor	34	32	31	39	28	23
Total	100	100	100	100	100	100
Number of families	29	25	26	18	40	22

*One homemaker had completed only 6 grades; the remainder had had more schooling.

members had preparation ratings of good. White families of this study averaged 3.5 members, Negro families 3.6 members. Median size of family (the size halfway between the largest and smallest) for both whites and Negroes was three members.

The fact that younger homemakers, especially younger Negro homemakers, had more schooling than older homemakers may account, at least in part, for differences in food preparation ratings of older and younger women. More schooling makes for more understanding of the printed word, in which form findings of research in food preparation are available. Most of the white homemakers with college training, and most of the Negro homemakers with 10 grades or more schooling, were under 45 years of age. Figure 1 shows preparation rating of white and Negro homemakers with varying amounts of schooling.

In table 6 is given food preparation ratings of families with homemakers of varying amounts of schooling. As will

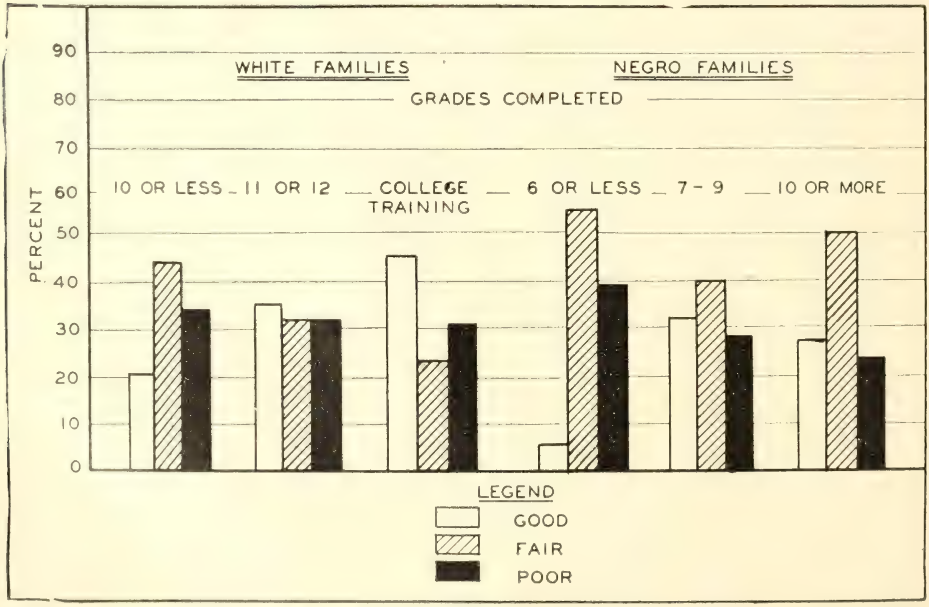

Figure 1. Food preparation ratings of white and Negro families and schooling of homemaker.

be noted, there were twice as many white families and five times as many Negro families with preparation ratings of good in families classified in category of most schooling for homemaker as classified in category of least schooling for homemaker. The fact that there were 19 women with less than seven grades schooling willing to cooperate in this study, was because other members of their families with more schooling were willing to keep the records for them and, also, because they had a supervisor to assist them.

Foods courses, such as are taught in departments of home economics of junior high schools, senior high schools, colleges, and by agricultural extension clubs, give up-to-date information on food preparation. Unfortunately, classroom and club teaching is not always carried back into the home. Then, too, this subject matter is continually changing. Methods of preparation recommended in 1923 or 1933 cannot be used today. However, if food teachers do a good job, their students will be well aware of the changing nature of this science of food preparation and be ever on the alert for the latest developments.

Families in which there were one or more members who had had training in home economics were more likely to own books, bulletins, pamphlets, and to subscribe to magazines dealing with food in its various aspects.

In table 7 and figure 2, food preparation ratings of families with one or more members having studied home economics in school, college, or club are compared with families with no member having had such training. About three-fourths of the white families and four-tenths of the Negro families had one or more members with some training in home economics—a much higher proportion than was the case with families of the larger study from which these families were drawn. More home economics training in families of this record sample may have been one factor in their better rec-

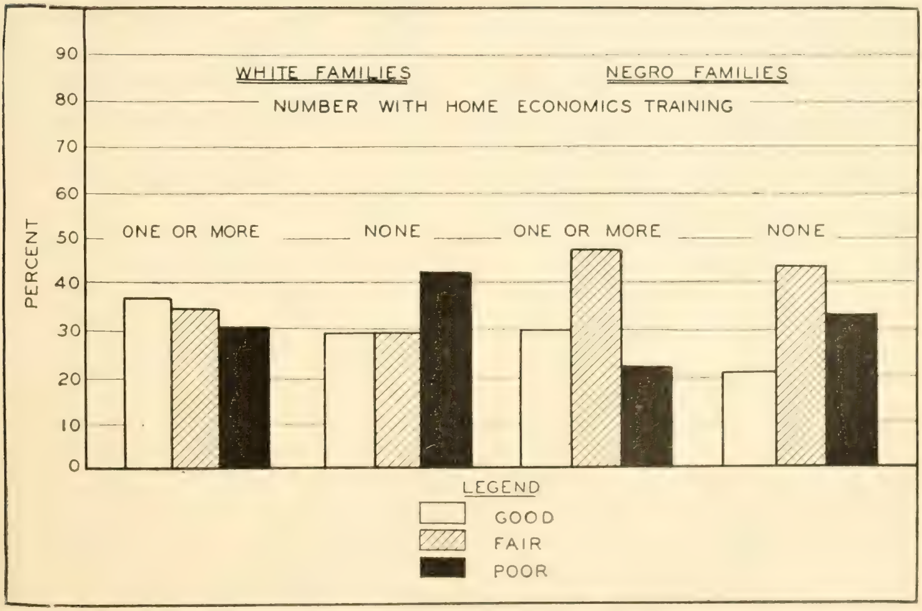

Figure 2. Food preparation ratings of white and Negro families with one or more members having had home economics training and with no member having had home economics training.

Table 7. Food preparation ratings of families in which one or more members had had training in home economics in school, college and/or agricultural extension clubs and in which no member had had training in home economics, college, and/or agricultural extension clubs.

Food preparation ratings	White families		Negro families	
	One or more members with training in home economics	No member with training in home economics	One or more members with training in home economics	No member with training in home economics
	Percent	Percent	Percent	Percent
Good	36	29	30	21
Fair	34	29	48	45
Poor	30	42	22	34
Total	100	100	100	100
Number of families	59	21	33	47

Table 8. Food preparation ratings of families classified by housing value.

Food preparation ratings	White families		Negro families	
	Housing value $20 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
	Percent	Percent	Percent	Percent
Good	25	44	23	27
Fair	29	38	44	49
Poor	46	18	33	24
Total	100	100	100	100
Number of families	41	39	39	41

ord of use and preparation of 12 foods than that of the larger group from which they were drawn.

Economic Status of Family and Food Preparation Rating

Housing value (monthly rent or rental value, unfurnished, of house or apartment in which the family resided) was used in this study as a basis for classifying families into economic groups. As will be noted from table 8 and figure 3, forty-six percent of the white families with housing values of $20.00 and under, and 18 percent with housing values of $20.01 to $40.00, had preparation ratings of poor. Thirty-three percent of the Negroes with housing values of $7.50 and under, and 24 percent with housing values of $7.51 to $20.00, had preparation ratings of poor. Members of families residing in houses of less value had completed fewer grades in school. The women and girls in these families had less often studied home economics. These families had less reading material to assist them in better food preparation. Facilities for food preparation were not as good as for the group with higher housing value. The low socioeconomic status family is, therefore, doubly disadvantaged as far as food consumed by the family is concerned. The food supply it consumes is less adequate in amounts of the various nutrients. The methods of preparation and/or serving they use are less likely to be methods that conserve the nutrients.

Family Background of Homemaker and Male Head and Food Preparation Rating

Husbands and wives in families of this study were rather homogeneous as far as family background was concerned. On the family history schedule, the following question was asked: "Any other factors that might account for methods of food preparation used: nationality of homemaker and male head, religion, experience of parents or grandparents?" Practically all homemakers and male heads in the 160 families included were Protestant, native white or Negro, reared on a Mississippi

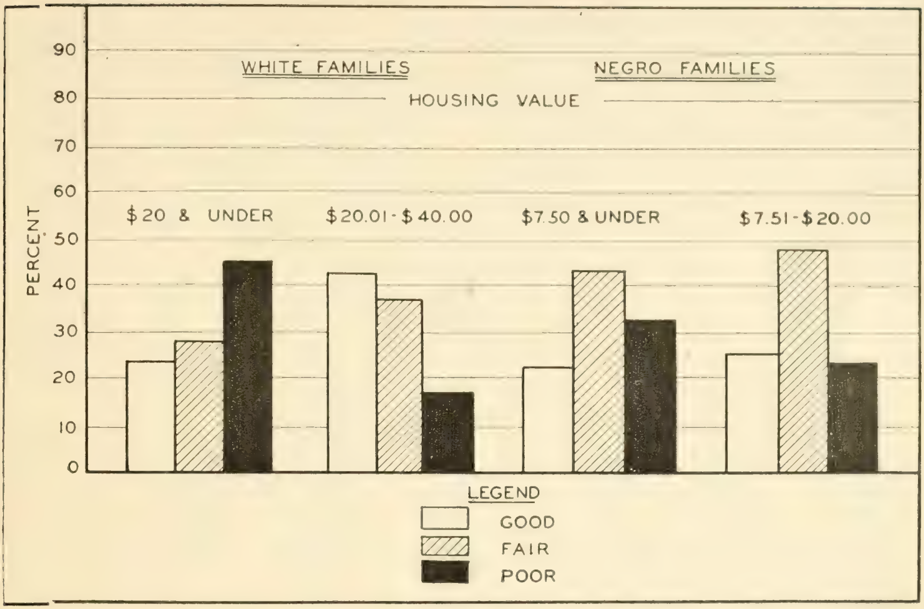

Figure 3. Food preparation ratings of white and Negro families classified by housing value.

farm. In only 13 families, 10 white and 3 Negro, had both male head and homemaker been reared in town. In only three families had both been reared outside the State, and in two of these families they had been reared in another Southern state.

In nearly 60 percent of the Negro families, either the homemaker, male head, or their parents had been house servants in the home of a white family, during which period they had eaten in the home of this family. Homemakers in 30 of the 80 Negro families had, themselves, worked and eaten regularly in homes of white families.

As will be noted from table 9, Negro homemakers who had eaten regularly in homes of white families, less often had food preparation records scoring poor than did those who had not had this experience. However, there were slightly more Negro homemakers scoring good in food preparation in the group who had never eaten regularly in the home of a white family. Included in this group were Negro women who were especially advantaged as far as schooling and economic status were concerned.

All except 12 white and 14 Negro

Table 9. Food preparation ratings of Negro families in which the homemaker had and had not at one time eaten regularly in the home of a white family.

Food preparation ratings	Homemaker had eaten regularly in home of white family	Homemaker had not eaten regularly in home of white family
	Percent	Percent
Good	23.3	26.0
Fair	53.4	42.0
Poor	23.3	32.0
Total	100.0	100.0
Number of families	30	50

homemakers of this study had assisted with preparation of food in parental homes. Assistance ranged from watching the bread or turnip greens to doing all the cooking for the parental family. The principal reasons given for no preparation experience in parental home was a sister helping with the cooking, and the homemaker being responsible for other household or farm tasks, and not being permitted by the cook to come into the kitchen. There was a rather marked tendency for families in which the homemaker had not had experience in food preparation in her parental home to make higher preparation ratings. It may be that women without previous experience in preparation are less tradition bound. However, the number of cases of those without preparation experience in parental home was small. Methods used in the preparation of vegetables and breads were often reported by homemakers as those taught them in their parental homes. The source of the methods of preparation for meats and for vegetable salads was less often that of the parental home.

Male heads in 25 of the white families and in 18 of the Negro families had assisted parental families with food preparation. One homemaker stated that her husband had taught her to cook.

Time Expenditures in Food Preparation and Scheduling of Homemaker

Most of the dishes for which records were kept were prepared by the homemaker. Ninety-four percent of the breads, 91 percent of the vegetable dishes, 90 percent of the meat dishes, and 80 percent of the salads were thus prepared.

White families in which the minimum time was spent in food preparation more often made preparation ratings of good than did white families in which the maximum time was spent in food preparation (table 10). In the Negro families, however, there were slightly more ratings of good in the group spending the maximum time, but more ratings also of poor in this group. Homemakers, both white and Negro, in families with poor preparation ratings spent on the average a little more time in food preparation than did those in families with good ratings.

There was, however, a closer relationship in the time in which the homemaker scheduled food preparation activities and

Table 10. Food preparation ratings of white and Negro families and total time spent in food preparation per family per week.

Group	Total time spent in food preparation by all persons during record week		
	Less than 15 hours	15 to 18 hours	More than 18 hours
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	45.0	39.1	24.3
Fair	15.0	26.1	46.0
Poor	40.0	34.8	39.7
Total	100.0	100.0	100.0
Number of families	20	23	37
Negro families			
Preparation ratings:			
Good	18.5	36.0	21.4
Fair	51.8	44.0	42.9
Poor	29.7	20.0	35.7
Total	100.0	100.0	100.0
Number of families	27	25	28

food preparation ratings than in the total time she spent in such activities and food preparation ratings. As will be noted from table 11 and figure 4, when the interval between beginning preparation and serving dinner was 1½ hours or less, 55

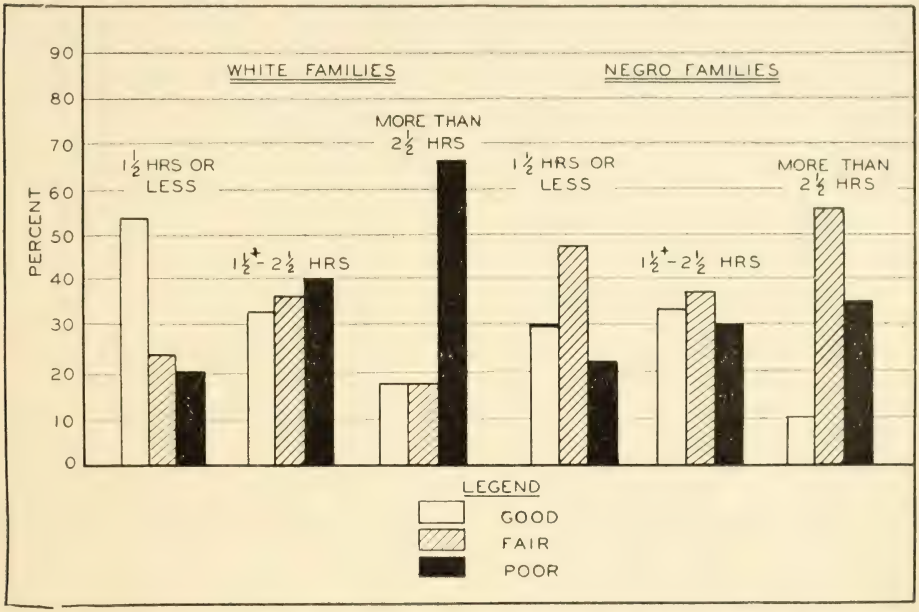

Figure 4. Food preparation ratings of white and Negro families and interval between beginning preparation and serving dinner.

Table 11. Food preparation ratings of white and Negro families and interval between beginning preparation and serving dinner (Monday through Friday).

Group	Time (median) between beginning preparation and serving dinner		
	1½ hours or less	More than 1½-2½ hrs.	More than 2½ hours
White families	Percent	Percent	Percent
Preparation ratings:			
Good	55.2	23.3	16.7
Fair	24.1	36.7	16.7
Poor	20.7	40.0	66.6
Total	100.0	100.0	100.0
Number of families*	29	30	12
Negro families			
Preparation ratings:			
Good	29.6	33.3	10.0
Fair	48.2	37.1	55.0
Poor	22.2	29.6	35.0
Total	100.0	100.0	100.0
Number of families	27	27	20

*In 9 white families and 6 Negro families, homemakers did not, themselves, prepare dinner as many as 4 days out of the Monday-Friday period. These 15 families are not included in the tabulation. This tabulation is limited to the Monday-Friday period, since time expenditures of homemakers on Saturday and Sunday differed greatly from expenditures during the remainder of the week.

percent of the white families and 30 percent of the Negro families rated good, 21 percent of the white families and 22 percent of the Negro families rated poor. When the interval between beginning preparation and serving was more than 2½ hours, 17 percent of the white families and 10 percent of the Negro families rated good, 67 percent of the white families and 35 percent of the Negro families rated poor. A homemaker may put her greens on at 9:00 a. m. and leave them cooking while she cleans house and does the laundry, or she may clean the house and start the laundry before putting on the greens. In either case, her time expenditures in preparation of the greens would be the same. The product, however, would differ.

Time scheduling is important in food preparation. That there was such a close relation in time of starting dinner and rating in food preparation was because starting dinner early usually meant starting vegetables early and this meant overcooking or having to keep them warm until serving time, or both. Of those white families in which all vegetables, for which records were kept, were excessively cooked and/or stored warm until served, the interval between beginning dinner preparation and serving dinner of 14 percent was 1½ hours, and of 50 percent, more than 2½ hours (table 12). Percentages for corresponding groups in which 50 percent or fewer vegetables, for which records were kept, were excessively cooked and/or stored warm until served were 50 and 17, respectively.

Poor cooking practices are no doubt tied up in part with time patterns inherited by homemakers from the past. There is need for continual study of best time for doing various preparation tasks. Which foods can be prepared first and which reserved for last minute preparation? The answer to these questions changes with the developments of research, new products, and equipment. Then, too, other tasks of the homemaker must be considered, for food preparation is only one of a number.

Type of Menu Served and Preparation Rating

From table 13, it would seem that families serving the least and the most dishes during the study week were more likely to have poorer methods of preparation than those serving a moderate number. The group serving 75 or fewer dishes during the study week were Negro families of low economic status. They had had little schooling and had been less often exposed to modern food preparation instruction. Facilities for preparing and for serving were limited.

Dishes served were of three types: (1) prepared dishes, (2) left-overs, and (3) ready prepared dishes. For example, fried steak, scalloped potatoes, biscuit, if

Table 12. Interval between beginning dinner preparation and serving dinner, and proportion of vegetables served cooked too long and/or stored hot too long before serving.

Proportion of vegetables served which were cooked too long and/or stored hot too long before serving	White families			Negro families		
	Interval between beginning dinner preparation and serving dinner*			Interval between beginning dinner preparation and serving dinner*		
	1½ hours or less	More than 1½-2½ hrs.	More than 2½ hours	1½ hours or less	More than 1½-2½ hrs.	More than 2½ hours
	Percent	Percent	Percent	Percent	Percent	Percent
100 percent	14.3	38.7	50.0	44.5	55.6	70.0
Fewer than 100 percent, more than 50 percent	35.7	38.7	33.3	40.7	40.7	30.0
50 percent or fewer	50.0	22.6	16.7	14.8	3.7	0
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	28	31	12	27	27	20

*Limited to the Monday-Friday period for reasons previously stated.

Table 13. Food preparation ratings of white and Negro families and total number of dishes served at meals during the record week.

Group	Number dishes served at meals per family per week		
	75 and under	76 to 110	111 and over
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	—	39.3	30.8
Fair	—	35.7	30.8
Poor	—	25.0	38.4
Total	—	100.0	100.0
Number of families	—	28	52
Negro families			
Preparation ratings:			
Good	17.9	32.5	—
Fair	51.3	40.0	—
Poor	30.8	27.5	—
Total	100.0	100.0	—
Number of families	39	40	1

prepared for the meal in which served, were considered as prepared dishes Prepared dishes left from a previous meal were classified as left-overs. Milk, butter, crackers, bakery rolls, jelly (either homemake or purchased) are examples of ready-prepared dishes. These dishes are in a form ready for eating with little or no expenditure of time in preparation.

About 11 percent of the dishes served by white families serving from 76 to 110 dishes during the study week were left-overs. About the same percentage served by Negro families serving fewer than 76 dishes and serving from 76 to 110 dishes during this period were left-overs. However, 20 percent of the dishes served by white families serving more than 110 dishes were left-overs. Many families in the white group serving so many dishes were following the traditional menu pattern for supper—left-overs from dinner for supper. This meant for supper a repetition of dinner rather than a simpler meal. Homemakers who follow traditional menu patterns may also follow traditional methods of preparation. This would account for lower preparation ratings with the greater use of left-overs.

In table 14, white and Negro families in the three preparation rating groups are classified according to number of left-overs served during the record week. As will be noted, families serving the greatest number of left-overs more often had preparation ratings of poor, while those serving the fewest number more often had preparation ratings of good or fair. Cooked vegetables even when stored covered in the refrigerator lose some nutritive value. Therefore, the practice of serving for supper left-over vegetables from dinner is not desirable. From a nutritional standpoint, a supper with a hot dish and fresh salad or fruit, or of sandwiches, salad, and fruit, is more desirable.

Families serving more prepared and ready-prepared dishes, more often had food preparation scores of good than those serving fewer of these dishes. Those serving fewer prepared and ready-prepared dishes more often had food preparation ratings of poor (table 15). The fact that families of higher economic status served more prepared and ready-prepared dishes would account in part for their better preparation ratings (table 8).

Equipment and Utensils for Food Preparation and Preparation Rating

Kitchen equipment such as a sink with drain boards, an electric, gas or oil cookstove, a mechanical refrigerator, were not

Table 14. Food preparation ratings of white and Negro families and number of left-over dishes served during study week.

Group	Number of left-over dishes served at meals per family per week		
	7 and under	8-18	19 and over
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	61.5	48.0	16.7
Fair	30.8	28.0	35.7
Poor	7.7	24.0	47.6
Total	100.0	100.0	100.0
Number of families	13	25	42
Negro families			
Preparation ratings:			
Good	31.6	16.7	25.0
Fair	44.7	53.3	33.3
Poor	23.7	30.0	41.7
Total	100.0	100.0	100.0
Number of families	38	30	12

Table 15. Food preparation ratings of white and Negro families and number of prepared dishes and of ready-prepared dishes served at meals during study week.

Group	Number prepared dishes			Number ready-prepared dishes		
	45 & under	46 - 60	61 & over	Under 20	20 - 35	36 & over
	Percent	Percent	Percent	Percent	Percent	Percent
White families						
Preparation ratings:						
Good	—	27.5	38.5	—	24.1	40.1
Fair	—	25.0	41.0	—	34.5	25.0
Poor	—	47.5	20.5	—	41.4	34.9
Total	—	100.0	100.0	—	100.0	100.0
Number of families	1	40	39	7	29	44
Negro families						
Preparation ratings:						
Good	19.5	37.1	—	19.6	36.7	—
Fair	47.2	37.1	—	45.7	43.3	—
Poor	33.3	25.8	—	34.7	20.0	—
Total	100.0	100.0	—	100.0	100.0	—
Number of families	36	35	9	46	30	4

owned by Negroes to any extent and, therefore, it is not possible to compare preparation ratings of groups with and without such equipment. Only two of the 80 Negro families had kitchen sinks with one or more drain boards; only one an electric, gas or oil cookstove; only 8 mechanical refrigerators.

In table 16, the relation of ownership of these three types of equipment by white families and their food preparation ratings are shown. Families who did not own this equipment made more frequently low food preparation ratings. Difference in economic status of the groups owning and not owning the equipment may account for much of the difference in preparation ratings.

That ownership of an electric, gas, or oil cookstove seemed more favorable than did ownership of a sink with drains or a mechanical refrigerator was, as has been previously suggested, because homemakers with wood and/or coal ranges only, often cook dinner in the cool of the morning to avoid having continued heat in

Table 16. Relation of ownership of sink with one or more drains, an electric, gas or oil stove, and mechanical refrigerator to food preparation rating of 80 small town white families of Mississippi.

Group	Equipment owned					
	Sink 1 or 2 drains		Electric, gas or oil stove		Mechanical refrigerator	
	Yes	No	Yes	No	Yes	No
	Percent	Percent	Percent	Percent	Percent	Percent
White families						
Preparation ratings:						
Good	36.7	32.0	39.2	24.1	32.7	35.7
Fair	43.3	26.0	35.3	27.6	36.5	25.0
Poor	20.0	42.0	25.5	48.3	30.8	49.3
Total	100.0	100.0	100.0	100.0	100.0	100.0
Number of families	30	50	51	29	52	28

the kitchen. (All white families except one not having a mechanical refrigerator, had an ice refrigerator; only 14 of the 50 families not having a sink with drains had no sink; and the remaining 36 had a sink with no drain boards.) They keep the dinner warm until noon when it is served. This practice is destructive of vitamins. Figure 5 shows the preparation ratings of white families with and without electric, gas or oil cookstoves.

There seemed to be little relation in ownership of common cooking utensils and preparation rating (table c in Appendix). In other words, families owning double boilers or equivalent made about as good preparation ratings as those not owning them. Families owning roasting pans made about as good ratings as those who did not. However, families with measuring cups and spoons and with paring knives, more frequently had good ratings, less, poor ratings.

Size of Kitchen and Preparation Rating

It was thought that size of kitchen

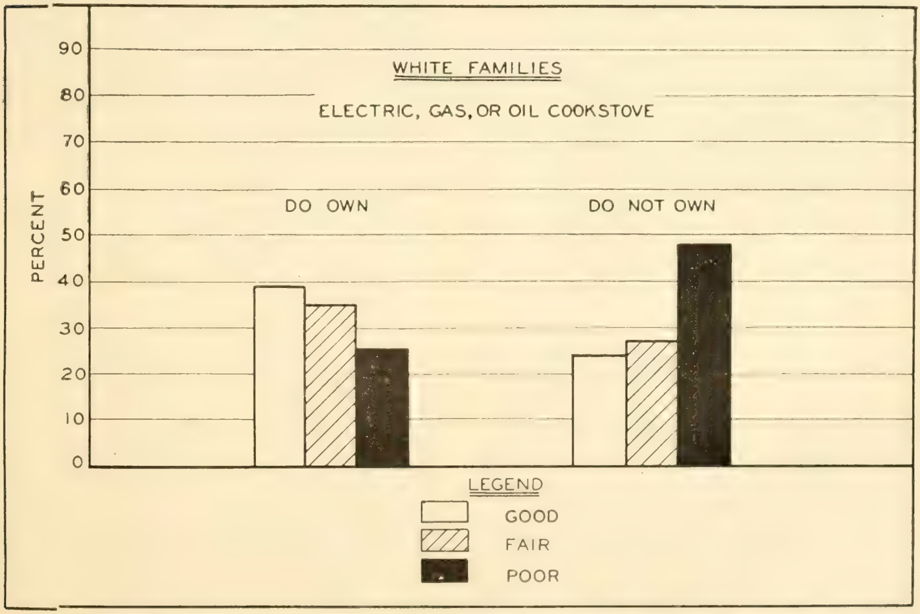

Figure 5. Food preparation ratings of white families and ownership of electric, gas or oil cookstove.

Table 17. Food preparation ratings of white and Negro families and size of kitchen.

Group	Size of kitchen		
	100 sq. ft. and less	101-160 sq. ft.	Over 160 sq. ft.
	Percent	Percent	Percent
White families			
Preparation ratings:			
Good	28.6	31.4	41.6
Fair	19.0	42.9	29.2
Poor	52.4	25.7	29.2
Total	100.0	100.0	100.0
Number of families	21	35	24
Negro families			
Preparation ratings:			
Good	17.9	25.7	35.3
Fair	50.0	51.4	29.4
Poor	32.1	22.9	35.3
Total	100.0	100.0	100.0
Number of families	28	35	17

might affect food preparation, a very large kitchen causing extra steps and time, a very small kitchen causing crowded work facilities, resulting also in loss of time. Such situations might encourage homemakers to start meal preparation sooner than would be the case with a kitchen of moderate size.

As will be noted from table 17, families, both white and Negro, with kitchens of 100 square feet and less, made lower ratings than did those with larger kitchens. Families with moderate sized kitchens more often rated fair and less often poor than did families with large or small kitchens. However, white and Negro families of this study with large kitchens were more likely to have food preparation ratings of good.

Storage Facilities and Preparation Rating

In table d in the Appendix, white and Negro families in the three food preparation rating groups are classified by kitchen storage facilities which they have. Families with kitchen closets or pantries, with built-in kitchen cabinets, with other kitchen cabinets such as cabinets with compartments for flour, sugar, a rolling board, and with cellars or outhouses, had better preparation ratings than did those without such facilities. This was, at least in part, because families with better storage facilities were also families of better economic status and education.

One interesting exception to the rule "ownership of storage facilities — better food preparation" was ownership of a kitchen safe, an outmoded piece of kitchen equipment, formerly quite popular for storage of cooked foods. Fifty-three percent of the white families and 38 percent of the Negro families with a kitchen safe had poor preparation ratings, while 28 percent of the white families and 25 percent of the Negro families having no kitchen safe had poor preparation ratings. Those with safes rated low because they used poor storage. Evidently those using better methods of storage had disposed of their safes.9/

9/Distance from the kitchen to the garden was also another factor considered as affecting food preparation. If, for instance, the garden was far from the kitchen, the homemaker might gather or have gathered the vegetables ahead of time, storing them inadequately until preparation time, whereas, if the garden was near the kitchen, she might go out when she was ready to prepare the meal, gather the vegetables, bring them in, and cook them immediately. This may be true of farm families whose gardens are often far from the house. In these town families, distance of the garden did not seem important. However, the majority of gardens were less than 36 feet from the kitchen.

Table 18. Food preparation ratings of white and Negro families and convenience of dishwashing unit and storage place for dishes.

Food preparation ratings	White families		Negro families*	
	Storage place for dishes near dishwashing unit	Storage place for dishes not near dishwashing unit	Storage place for dishes near dishwashing unit	Storage place for dishes not near dishwashing unit
	Percent	Percent	Percent	Percent
Good	36.4	28.0	22.6	25.6
Fair	32.7	32.0	51.6	38.4
Poor	30.9	40.0	25.8	36.0
Total	100.0	100.0	100.0	100.0
Number of families	55	25	31	39

*In 10 Negro families dishes were stored on the table on which they were washed.

Table 19. Food preparation ratings of white and Negro families and convenience of stove to dining table.

Food preparation ratings	White families		Negro families	
	Stove near to dining table	Stove not near to dining table	Stove near to dining table	Stove not near to dining table
	Percent	Percent	Percent	Percent
Good	50.0	26.8	37.5	19.6
Fair	16.7	39.3	45.8	44.6
Poor	33.3	33.9	16.7	35.8
Total	100.0	100.0	100.0	100.0
Number of families	24	56	24	56

Convenience as well as possession of storage facilities and food preparation rating are related (table 18). Here, too, economic situation is one factor, families with dish cabinets near sinks more often being families of higher economic status.

Location of Dining Table With Respect to Stove and Serving Unit and Food Preparation Rating

According to Miss Maud Wilson, two important connections between working surfaces and areas concerned with preparation and consumption of food are: (1) stove near to dining table; (2) serving unit near to dining table.[10] These connections were investigated in this study as it was thought that convenience of stove to dining table, and of serving unit to dining table, might mean less standing around of food, and hence, better prepared food. "Near to" was defined as connecting or only two or three steps between, with no other equipment to be walked around.

Another connection mentioned as important by Miss Wilson was nearness of refrigerator to serving unit. However, in this study there were only 24 families (19 white and 5 Negro) with the refrigerator near the serving unit. Most of these 24 families were owners of mechanical refrigerators. Ice refrigerators are often kept outside the kitchen.[11]

When the stove and dining table were near, when the serving unit and dining table were near, there were more ratings of good food preparation, fewer of poor food preparation (tables 19 and 20). As will be noted, 50 percent of the white

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[10] The Williamette Valley Farm Kitchen, Maud Wilson, Oregon. Agri. Exp. Sta. Bull .No. 356, Aug. 1938, p. 17.

[11] Other connections studied were location of stove with respect to dishwashing unit; location of mixing unit with respect to dishwashing unit; location of dining table with respect to dishwashing unit. Families with these areas connecting or only two or three steps between with no other equipment to be walked around had no better, and in many cases not as good, preparation ratings than did those with areas not near.

Table 20. Food preparation ratings of white and Negro families and convenience of serving unit to dining table.

Food preparation ratings	White families*		Negro families*	
	Serving unit near to dining table	Serving unit not near to dining table	Serving unit near to dining table	Serving unit not near to dining table
	Percent	Percent	Percent	Percent
Good	45.8	20.8	30.8	18.4
Fair	20.8	39.6	38.4	50.0
Poor	33.4	39.6	30.8	31.6
Total	100.0	100.0	100.0	100.0
Number of families	24	48	13	38

*In 8 white families and 29 Negro families, the serving unit and the dining table were the same.

families and 38 percent of the Negro families with stove and dining table near made preparation ratings of good, while 27 percent of the white families and 20 percent of the Negro families in which this equipment was not near made preparation ratings of good (table 19). Forty-six percent of the white families and 31 percent of the Negro families with serving unit and dining table near, and 21 precent of the white families and 18 percent of the Negro families with this equipment not near made preparation ratings of good. This suggests that convenience of stove to dining table, of serving unit to dining table, may mean better prepared food. Further investigation is needed here.

Nearly 60 percent of the white families and about 75 percent of the Negro families ate entirely or most of the time in their kitchens. However, about 70 percent of the white families had a dining room or both dining room and breakfast room. Forty percent of the Negro families had a dining room. Families in this study who ate in the kitchen all or part of the time made on the whole somewhat better preparation ratings than families eating in another room.

Summary and Conclusions

The purpose of this investigation was to study some of the factors probably related to food preparation. The factors examined were family composition, schooling, and food and nutrition information of homemaker, economic status of family, family background of homemaker and male head, time expenditures in food preparation, scheduling of homemaker, type of menus served, equipment for food preparation, and arrangement of this equipment.

One hundred and sixty families were included—80 white families with housing value of $20.00 and under and of $20.01 to $40.00, and 80 Negro families with housing value of $7.50 and under and of $7.51 to $20.00. (Housing value is defined as monthly rent or rental value, unfurnished, of house or rooms in which the family resided.)

Data were obtained in the summer of 1943 from records kept by homemakers and from schedules filled out by means of personal interviews with these women. White and Negro home economists supervised record keeping and secured other information by interviewing the homemaker.

The 160 white and Negro homemakers kept records of 1,857 of the dishes they prepared during the record week. The dishes for which records were kept were limited to vegetables, meat and eggs, breads and vegetable salads. Most of the dishes for which records were kept were prepared by the homemaker—94 percent of the breads, 91 percent of the vegetable dishes, 90 percent of the meat dishes, and 80 percent of the salads. Food preparation of each family was rated according to average number of poor practices (or practices contrary to recommendations of food and/or nutrition specialists) per dish per preparation record kept. Families were classified into three groups: (1) **good preparation,** including those with less than one poor practice per dish; (2) **fair preparation,** those with from 1 to 1.5 poor practices per dish; (3) **poor preparation,** those with more than 1.5 poor practices per dish. Twenty-nine percent of the 160 families rated thus had good preparation, 40 percent fair preparation, and 31 percent poor preparation.

Families with younger homemakers made better preparation ratings. The fact that younger homemakers had more schooling than older homemakers was in part responsible. Schooling of homemaker and preparation rating seemed to be related.

Families in which one or more members had studied home economics in school, college, or club had somewhat better preparation ratings than those in which no member had had this training.

Families residing in houses of lower rent or rental value more frequently made preparation ratings of poor than did those residing in houses of higher rent or rental value. Homemakers in the lower housing value groups had less schooling. The lower housing value families less often had members who had studied home economics, less often had reading material to assist them in better food preparation, had poorer facilities for food preparation.

Negro homemakers who had eaten regularly in homes of white families less frequently had food preparation records scoring poor than did those who had not had a similar experience. However, there were slightly more Negro homemakers scoring good in food preparation in the group who had never eaten regularly in the home of a white family.

Methods used in the preparation of vegetables and of breads were often reported by homemakers as those taught them in their parental homes. The source of the method of preparation for meats and for vegetable salads was less often reported by homemakers as that taught them in parental home.

There was a tendency for those families in which the maximum time was spent in food preparation to have more often ratings of poor. There was likewise a tendency for families with homemakers spending more time in food preparation to have lower preparation ratings.

There was, however, a closer relationship in the time in which the homemaker scheduled food preparation activities and food preparation rating than in total time she spent in such activities and food preparation ratings. When the interval between beginning preparation and serving dinner was 1½ hours or less, 55 percent of the white families and 30 percent of the Negro families rated good, 21 percent of the white families and 22 percent of the Negro families rated poor. When the interval between beginning preparation and serving dinner was more than 2½ hours, 17 percent of the white families and 10 percent of the Negro families rated good, 67 percent of the white families and 35 percent of the Negro families rated poor. Starting dinner early often meant starting vegetables early and this meant overcooking or having to keep them warm until meal time.

Families serving the greatest number of left-overs at meals during the study week more often had preparation ratings of poor. The traditional supper meal is left-overs from dinner. Homemakers who follow traditional menu patterns may also follow traditional methods of preparation.

Families serving more prepared and ready-prepared dishes at meals during the study week more often had preparation ratings of good; those serving fewer of these dishes less often had ratings of good. The number of these two types of dishes served seems to be related to economic status of the family.

Families owning food preparation equipment such as a sink with one or two drains, an electric, gas or oil cookstove, a mechanical refrigerator, had better preparation ratings than those not owning such equipment. Ownership of an electric, gas or oil cookstove seemed favorable for good preparation. This was not only because families of higher economic status more often had such equipment, but because wood and/or coal ranges used in lieu of the others cause continued heat in the kitchen. To avoid this, many homemakers cook dinner in early morning, allowing it to remain on the stove until served. This practice is destructive of vitamins.

Families with kitchens of 100 square feet or less made lower preparation ratings than did those with larger kitchens. Small kitchens cause crowded work facilities and inadequate storage. Families with good storage facilities such as kitchen pantries, built-in cabinets, kitchen cabinets, had better preparation ratings than did those without such facilities. Convenience as well as possession of storage facilities seemed important in food preparation.

When the stove and dining table were near, and when the serving unit and dining table were near, there were more ratings of good preparation, fewer of poor food preparation. Convenience of this equipment may mean less standing around of food, and hence, better prepared food

Preparation ratings are the sum total of many factors. No single one can account for ratings of "good." In this particular investigation there were too few families to study the interrelationships of all the factors.

White families seemed a more homogeneous group on the basis of food preparation rating and education when analyzed statistically. There is need for further study of this problem, for it is on the basis of such study that effective programs to improve practices can be developed.

From this study it would seem that better preparation would result (1) with more schooling, especially for homemakers in low socioeconomic families, since better preparation is dependent in part on better understanding of the spoken and printed word; (2) with home economics training for all homemakers; (3) with higher incomes for low socioeconomic status groups in order that they may obtain more of the material, and cultural equipment that makes better preparation more easily obtainable; (4) with clearer understanding on the part of home economics educators of the role of tradition in food preparation, in menu patterns, in time expenditure patterns and the source of such traditions; (5) with clearer understanding on the part of home economists of activities that go on in homes in order that better assistance can be given in time scheduling and in the choice, use, and arrangement of equipmnet that facilitates good preparation. Close coordination between management and food and nutrition is very much needed.

APPENDIX

Food Preparation

Schedule (a) Family No.........

I. HOUSEWIFE FILLS OUT

BREADS

DATE SERVED				
NAME OF BREAD				
If **meal,** whether bolted or unbolted. If **flour,** whether plain or self-rising; whether white not enriched, white enriched, or whole-wheat				
Recipe (measure and weights)				
Cooked in hot or moderate oven?				
Thickness when done (inches)?				
How long baked?				
Served at next meal? How?				

II. SUPERVISOR FILLS OUT

Source flour or meal				
Describe method of mixing				
Who prepared?				
From whom was method learned?				
Members of family not eating bread				

Food Preparation

Schedule (b) Family No.

I. HOUSEWIFE FILLS OUT

EGGS

DATE SERVED				
NAME OF DISH				
Recipe				
When put on to cook?				
When finish cooking?				
When served?				
If scrambled, or fried, grease smoking, not smoking? If boiled, in boiling water or water below boiling? If baked, in hot or moderate oven?				
Was white tender or hard?				

II. SUPERVISOR FILLS OUT

Source				
Who prepared food?				
From whom was method learned?				
Members of family not eating food				

Food Preparation

Schedule (c) Family No. ....

I. HOUSEWIFE FILLS OUT

LEAN MEAT, FISH, POULTRY

DATE SERVED				
NAME OF DISH				
Recipe (measures or weights) (Include anything added to tender)				
When put on to cook?				
When finished cooking?				
When served?				
If fried, grease smoking? Not smoking? If baked, oven hot, moderate, cool? If boiled in water, simmering or boiling?				
Whether meat was rare, or well done when served. Whether juicy or dry?				
How prepared next meal?				

II. SUPERVISOR FILLS OUT

Source				
Describe method of preparing				
Who prepared?				
From whom was method learned?				
Members of family not eating food				

Food Preparation

Schedule (d) **Family No.**________

I. HOUSEWIFE FILLS OUT

COOKED VEGETABLES

DATE SERVED				
NAME OF VEGETABLE				
If fresh veg., young, average maturity, very mature				
Time started to prepare: washing, peeling, shelling, soaking, opening can				
If canned, was water drained off? If dried, was veg. soaked? Was veg. cooked in water in which soaked?				
Recipe (measures or weights)				
Container in which cooked. If steam pressure, give pressure used.				
Drained and more water added. Number times. Drained at end.				
Time vegetable put on stove?				
Time cooking complete?				
Time served?				
If interval, where kept until served?				
Was all pot liquor eaten? If not, give total no. cupfuls in all and no. cupfuls not eaten.				
Used next meal? If so, where and how stored? How prepared for next meal?				

Schedule (*d*) (Continued)

II. SUPERVISOR FILLS OUT

If home produced, when gathered and by whom?				
If purchased, when?				
Where and how had vegetable been stored in interval between gathering or purchasing and preparing?				
Parts discarded in preparation				
Was veg. soaked in water after being cut up before put on to boil? If so, how long? Kind of water soaked?				
Was veg. cooked whole, cut in halves, in quarters, in smaller pieces, shredded?				
Was veg. put on in boiling water or cold water, or in hot or moderate oven, or in hot or moderate grease?				
Was vegetable cooked with or without cover?				
When were seasonings added?				
Anything added to tender or to cook quicker?				
Who prepared vegetables?				
From whom was method learned?				
Members of family not eating vegetable				

Table a. Average number dishes served per family during record week of the type for which homemakers kept records.

Food type	Average number dishes served per family			
	White families		Negro families	
	Housing value $20.00 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
Vegetable	11.3	11.4	8.6	10.7
Meat and eggs	10.3	14.0	9.7	10.1
Bread	9.6	8.7	12.2	12.4
Vegetable salad	1.0	1.3	0.4	0.5
Sliced tomato	6.4	6.1	1.5	1.8
Number of families	41	39	39	41

Food Preparation

Schedule (e) Family No. ......

I. HOUSEWIFE FILLS OUT

VEGETABLE SALAD

DATE SERVED				
NAME OF SALAD				
If veg. raw: young, average maturity, very mature				
Time started to prepare salad. Were veg. crisp or wilted?				
What use was made of water if canned veg. was used?				
Recipe (measure or weight)				
Time preparation complete				
If time between finished preparing and mealtime, how long; where was salad kept?				
Was it used at next meal? If so, where and how stored between meals?				

II. SUPERVISOR FILLS OUT

If home produced, when gathered and by whom?				
If purchased, when?				
Where and how had veg. been stored in interval between gathering or purchasing and preparing?				
Parts discarded in preparation				
Were vegetables cut or shredded with knife, grated, cut in meat chopper, shredded in shredder?				
Were vegetables soaked in water after being cut up?				
If potato salad, cooked with or without peelings; if without, was water discarded?				
Who prepared salad?				
From whom was method learned?				
Members of family not eating salad				

Table b. Foods for which preparation records were kept by homemakers in white and Negro families during report week classified by housing value.

Foods for which preparation records kept	White families		Negro families	
	Housing value $20.00 and under	Housing value $20.01-$40.00	Housing value $7.50 and under	Housing value $7.51-$20.00
	Number	Number	Number	Number
Total vegetables	245	217	200	218
Fresh vegetables:				
Irish potatoes	34	31	18	27
String beans	17	17	8	13
Butter beans	39	39	25	28
Field peas	35	26	34	30
Okra	20	29	12	20
Corn	24	23	20	26
Cabbage	4	3	22	21
Turnip greens	3	3	10	7
Tomatoes	6	7	4	4
Vegetable soup	9	3	8	3
Collards	0	0	6	8
Squash	3	6	2	1
All other	27	17	12	12
Dried vegetables	7	1	12	11
Peas and beans	7	1	12	11
Canned vegetables	17	11	7	7
Frozen vegetables	0	1	0	0
Total breads	68	66	87	91
Cornbread	37	33	43	46
Biscuit	25	24	41	43
Other breads	6	9	3	2
Total salads	48	42	22	33
Sliced tomato	23	16	13	23
Potato	6	8	5	5
Slaw	10	2	3	3
All other	9	16	1	2
Total meats and eggs	96	129	141	154
Eggs	32	62	38	47
Beef	20	21	24	21
Steak	12	5	6	4
Roast	2	5	1	2
Other	6	11	17	15
Sausage, weiners, and bologna	4	2	19	22
Variety meats	1	2	3	5
Bacon or salt pork	2	2	10	15
Ham or cured shoulder	6	5	6	8
Chicken	17	23	17	20
Fried chicken	14	20	15	16
Other	3	3	2	4
Fresh pork	9	6	22	11
Chops	7	5	11	3
Ribs	0	0	9	5
Roast	2	1	1	2
Other	0	0	1	1
Fresh fish	2	3	1	3
Salmon, canned	3	3	1	2

Table c. **Food preparation ratings of white and Negro families and average number of cooking utensils of specified kind in usable condition owned.**

Item	White families				Negro families			
	Food preparation rating group				Food preparation rating group			
	Good	Fair	Poor	Family having 1 or more	Good	Fair	Poor	Family having 1 or more
	Av. no.	Av. no.	Av. no.	Number	Av. no.	Av. no.	Av. no.	Number
Sauce pans or kettles	5.6	6.0	5.6	80	4.5	4.4	3.7	79
Double boiler or equiv.	0.7	0.8	0.7	57	0.8	0.7	0.8	54
Frying pans	2.8	2.8	2.6	80	2.2	2.3	2.2	79
Baking pans	3.5	2.7	2.5	76	2.4	2.5	2.3	78
Paring knives	1.6	1.1	0.8	64	0.5	0.5	0.3	30
Cutting knives	1.8	1.6	1.6	78	1.9	1.7	1.5	74
Muffin pans, no. of cups	12.1	9.7	11.3	70	5.2	5.4	6.6	56
Sifters	1.0	1.1	1.2	77	1.0	1.0	1.1	75
Measuring spoons	1.3	1.2	0.9	38	0.4	0.2	0.2	15
Measuring cups	1.1	1.0	0.8	57	0.6	0.4	0.3	31
Steam pressure cooker	0.3	0.3	0.3	23	0.1	*	0.0	3
Roasters	0.8	0.7	0.6	49	0.4	0.3	0.3	27

*One owned.

Table d. Food preparation ratings of white and Negro families and kitchen storage facilities.

Kitchen storage facilities*	White families				Negro families			
	Food preparation rating group				Food preparation rating group			
	Good	Fair	Poor	Families having	Good	Fair	Poor	Families having
	Percent	Percent	Percent	Number	Percent	Percent	Percent	Number
Kitchen closet or pantry	33.3	38.9	27.8	35	36.3	45.5	18.2	11
No kitchen closet or pantry	33.3	26.7	40.0	45	23.2	46.4	30.4	69
Built-in kitchen cabinet	26.3	42.1	31.6	38	42.9	35.7	21.4	14
No built-in kitchen cabinet	40.5	23.8	35.7	42	21.2	48.5	30.3	66
Other kitchen cabinet	34.1	34.1	31.8	44	21.6	46.0	32.4	37
No other kitchen cabinet	33.3	30.6	36.1	36	27.9	46.5	25.6	43
Kitchen safe	26.3	21.1	52.6	19	20.8	41.7	37.5	24
No kitchen safe	36.1	36.1	27.8	61	26.8	48.2	25.0	56
Storage outhouse or cellar	46.7	36.7	16.6	30	26.3	42.1	31.6	19
No storage outhouse or cellar	26.0	30.0	44.0	50	24.6	47.5	27.9	61
None of storage facilities above	—	—	—	1	25.0	41.7	33.3	12
Kitchen closet or pantry and 1 or more other facilities	34.2	42.1	23.7	38	—	—	—	9

*Five white families and 2 Negro families had other storage, such as a shelf above a table. Percentages are not given where less than 10 families.

BULLETIN 434 APRIL 1946

The Vitamin A Potency of Creamery Butter Produced In Mississippi

By F. H. HERZER AND MARVIN GIEGER

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THE VITAMIN A POTENCY OF CREAMERY BUTTER PRODUCED IN MISSISSIPPI

By F. H. HERZER and MARVIN GIEGER

The Food and Nutrition Board of the National Research Council, in making wartime food recommendations, recognized that a seasonal variation in the vitamin A potency of milk and butter existed. While previous studies have disclosed many fundamental facts regarding the vitamin A content of butterfat, the actual variation of this substance in the butter offered the consuming public in the various sections of the United States at different seasons of the year was not known. A nation-wide study to learn these facts was recommended by the Bureau of Dairy Industry and the Office of Experiment Stations. To date the Experiment Stations of 19 states have participated in this project. The Mississippi Station began its first studies in March 1943.

An appraisal of the actual contribution which dairy products make to the national requirements was suggested by Palmer and Jenness, who estimated that the total vitamin A potency in the milk and milk products consumed in the United States is adequate to supply the vitamin A needs of 42,000,000 people. If by conserving the carotene in hays and silages and developing winter grazing, the vitamin A potency of winter milk could be increased to that of average summer milk, the vitamin A requirements of 11,000,000 more people could be satisfied. This would mean that 40 percent of the total units now considered essential in the human diet would be contributed by the dairy industry.

Since the vitamin A potency of milk depends upon the carotene content of the feeds consumed by the cow, conditions which are conducive to fresh growing pasture grasses, properly cured hay, and preserved silage, will enhance the vitamin value of the milk and at the same time stimulate production. Unquestionably, a higher vitamin A potency of milk and butter can be secured immediately and economically through better pasture management and the proper care of cured roughages.

Methods

Samples of butter were secured from three creameries located within a radius of 25 miles. These plants make about 60 percent of the butter manufactured in Mississippi. The samples selected by these plants represented butter of three general types, namely: that made from cream separated on the farm and delivered sweet to the creamery, designated as A; that from cream separated on the farm and held in most instances until sour before delivery to the plant, designated as B; and that from sweet cream secured by separating sweet milk at the plant, designated as C.

Much of the cream delivered to creamery A averaged 0.18 to 0.25 percent acidity. This cream was heated to 160° F. by a steam jet and agitated in a coil pasteurizer for 30 minutes at 155° F. before cooling to churning temperature. The bulk of this cream was churned within 1 or 2 hours after pasteurization.

The butter used in this project from creamery B was made from sour cream ranging in acidity from 0.5 to 1 percent, much of which originated with smaller shippers and cream stations scattered throughout the State. This was neutralized with sodium carbonate and sodium bicarbonate to approximately 0.25 percent acidity, forewarmed to 90° F. and flash pasteurized at 210° F. in a high temperature vacuum-type unit. As the hot cream sprayed into the vacuum compartment the temperature dropped to 140° F. This cream was immediately cooled to churning temperature over a surface cooler, held from 1 to 2 hours, and churned.

The cream used by creamery C was secured by separating fresh milk delivered to the plant. This cream had a very low acidity of 0.10 percent to 0.12 percent and was heated to 155° F. in a coil vat, pasteurized and held for 30 minutes before being cooled to churning temperature in the vat.

One pound samples of butter were secured from these creameries the first of each month. Analyses for carotene, vitamin A, and composition, (moisture, salt, curd, and butterfat) were made immediately. The butter was held in a 45° to 50° F. refrigerator to simulate storage conditions in the retail store and home refrigerator. At the end of 15 days and 30 days storage the same analyses were made. Since much of the butter produced in April, May, and June goes into cold storage, additional one-pound samples were stored at 0° F. for 5 months. This butter was then placed in a 45° F. storage, analyzed immediately and after storage for 15 days and after 30 days, to learn what effect, if any, storage and marketing routine might have on the vitamin A content.

Analytical Methods

The antimony trichloride method of determining vitamin A was used, the procedure being that of Koehn and Sherman.[1] Crystalline vitamin A alcohol (Distillation Products, Inc., 755 Ridge Road West, Rochester, New York) was used for vitamin A, Standard.

EXPERIMENTAL

Effect of Season

Approximately twice as much butter was made during the months of May, June, July, and August as in December, January, February, and March. This is shown in table 1 which lists the percentage of years' production of creamery butter manufactured each month during the year period from 1940 to 1944.

A statistical study of the analyses showed that there was no significant change in carotene and vitamin A content of the butter during the 15- and 30-day holding periods. All analyses of the nine samples of butter examined each month were therefore averaged in establishing the seasonal trend. The monthly variation in International Units of vitamin A per pound of butter throughout the year is shown in table 2 and graphically presented in figure 1.

A high level of vitamin A potency continued through July, August, September, and October 1943 and was resumed during April, May, and June of 1944. During these months the samples of butter averaged 18,230 International Units per pound. Since these values are probably representative of the entire State's make, approximately 70 percent of the annual butter production would be expected to contain a relatively high vitamin A potency.

The lack of feed of high carotene content such as properly preserved silage, high grade hay, fall and winter cover crops, is reflected in the lower levels reached during November, December, January, February, and March. During these months the total vitamin A potency averaged slightly over 12,000 International Units, the lowest level of 10,128 Units being reached in February.

With the appearance of pasture grasses and clovers some increase in vitamin A content is shown on March 1st, however, the effect of a plentiful supply of green feed is shown by the increase to 18,860 International Units on April 1st.

The carotene content of the butter reached both higher and lower levels than the vitamin A, ranging from 1.55 in March to 7.86 micrograms per gram of butter in August. The vitamin A content remained between the rather narrow limits of 4.42 on February 1st and 7.5 micrograms per gram of butter on

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[1] Koehn, C. J. and Sherman, W. C. The Determination of Vitamin A and Carotene with a Photoelectric Colorimeter. Jour. Biol. Chem., 132: 527-538. 1940.

Table 1. Mississippi butter production, 1940-1944, percentage by month.

Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
5.13	5.14	6.08	8.38	11.81	11.05	11.43	11.25	9.22	8.09	6.79	5.63

Table 2. Monthly average carotene, vitamin A and total vitamin A potency per pound of butter from three Mississippi creameries.

Production period	Carotene mcg./gm.	Vitamin A mcg./gm.	Vitamin A potency per pound, International Units
July 1943	7.70	6.15	17,812.4
August	7.86	6.35	18,325.0
September	7.35	6.34	17,921.6
October	5.92	6.40	16,955.2
November	5.33	5.24	14,252.1
December	3.49	5.08	12,546.6
January 1944	3.09	5.00	12,088.4
February	2.00	4.42	10,128.8
March	1.55	5.33	11,557.8
April	5.60	7.50	18,860.6
May	7.76	6.90	19,323.3
June	7.40	6.57	18,407.0

Table 3. Effect of one month's storage at 45° F. on the carotene and vitamin A content of butter.

	Carotene content after			Vitamin A content after		
Month	0 days mcg./gm.	15 days mcg./gm.	30 days mcg./gm.	0 days mcg./gm.	15 days mcg./gm.	30 days mcg./gm.
July	7.3	8.1	7.7	6.3	5.8	6.3
August	7.6	7.9	8.1	6.6	6.4	6.0
September	8.2	7.5	6.3	5.9	6.2	6.8
October	6.3	5.1	6.4	6.6	6.1	6.4
November	5.7	5.7	4.7	5.4	5.2	5.2
December	3.8	3.2	3.5	5.2	4.8	5.1
January	3.7	2.7	2.8	5.3	4.8	4.6
February	2.7	1.8	1.8	4.5	3.2	4.5
March	1.6	2.0	1.0	5.2	5.6	5.2
April	5.0	5.8	6.0	7.2	7.5	7.6
May	7.3	8.2	7.8	7.1	7.1	6.4
June	7.5	7.6	7.2	6.6	6.7	6.3
Average	5.56	5.47	5.28	6.0	5.78	5.87

April 1st. The vitamin A recovered from its downward trend March 1st, one month earlier than the carotene. However the carotene increased from 1.55 on March 1st to 5.6 on April 1st, which was the greatest spread between any two months of either material. During the months of low carotene intake, namely November, December, January, February, and March, approximately 20 percent of the total vitamin A potency was furnished by carotene, while during the remainder of the year 30 percent was supplied by carotene.

Effect of Short Storage

The values in table 3 are based on the average carotene and vitamin A content of the butter from the three creameries for the first, fifteenth, and thirtieth of each month. This butter was held in a 45° to 50° F. refrigerator in quarter-pound prints, and storage corresponded to retail store and home refrigerator conditions. The data presented indicate that both carotene and vitamin A were very stable.

Statistically, the variation in carotene and vitamin A due to 15- and 30-day

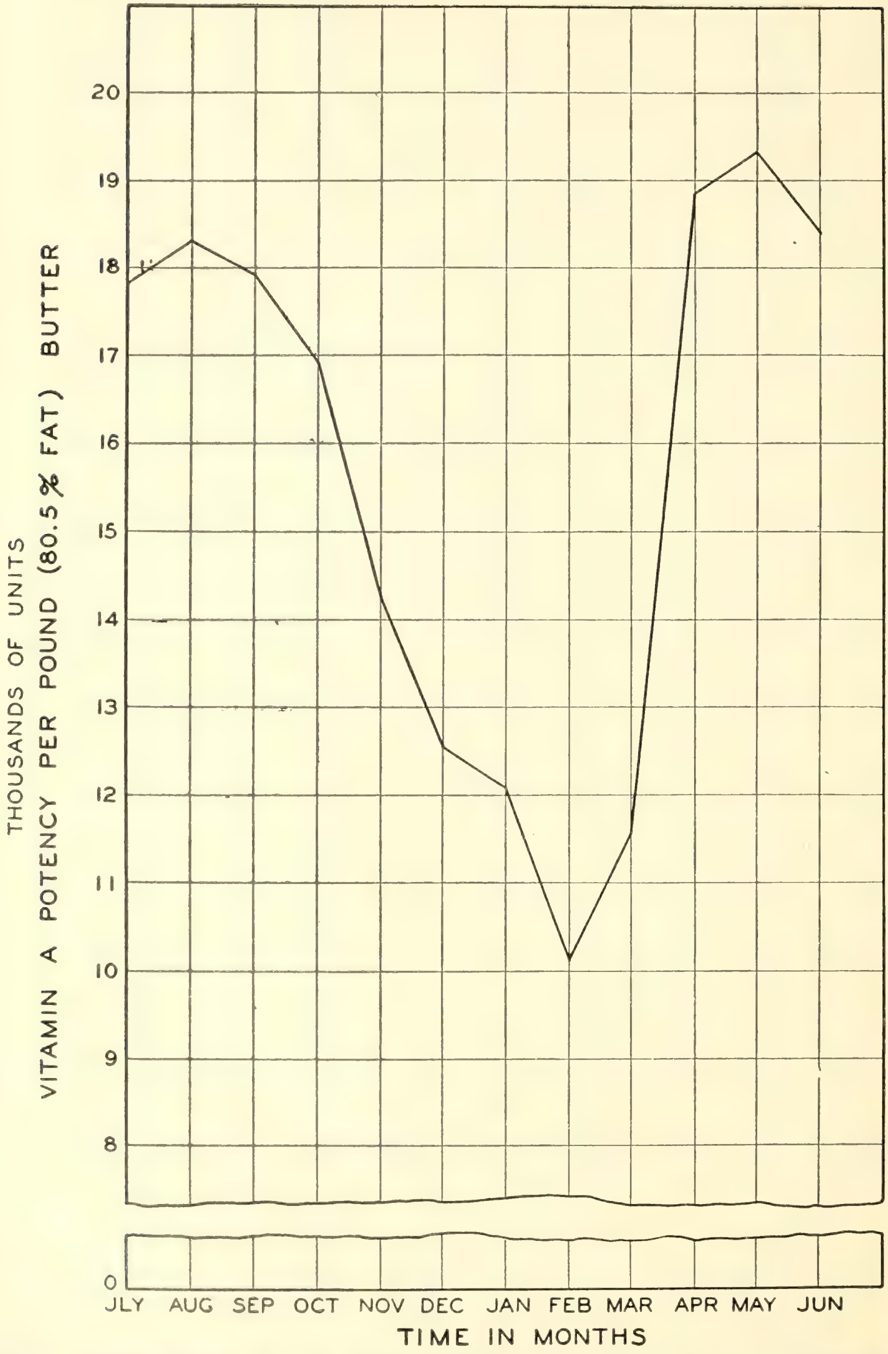

Figure 1. Seasonal variation of total vitamin A potency of the butter from three Mississippi creameries.

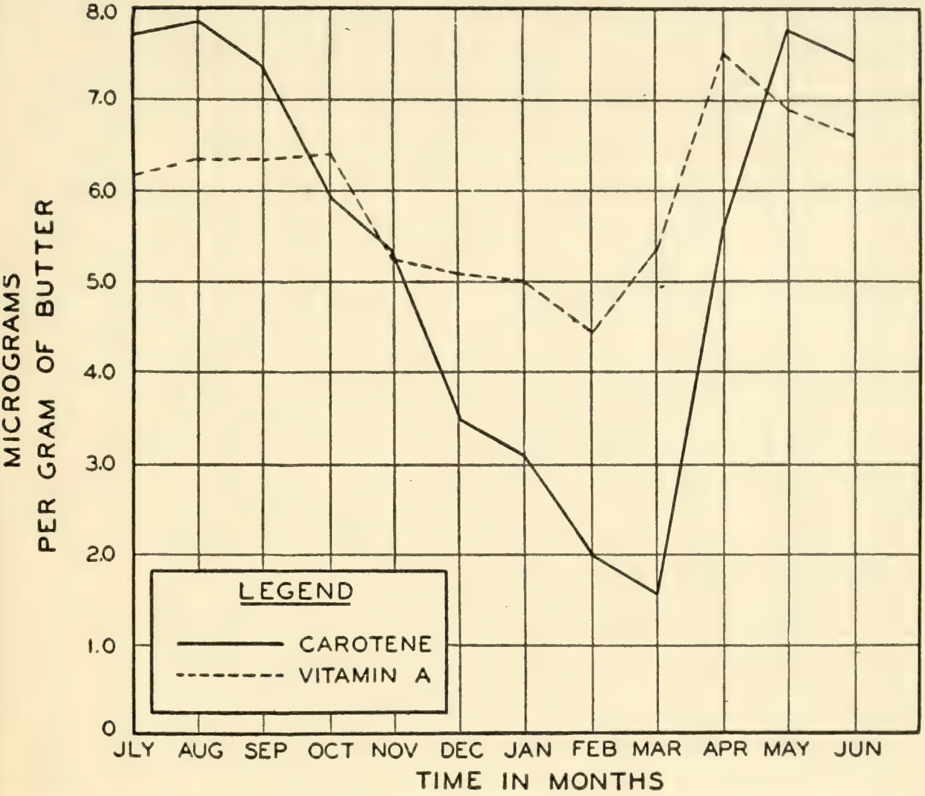

Figure 2. Seasonal variation of carotene and vitamin A in butter from three Mississippi creameries.

storage was not significant. F values for the 15- and 30-day storage periods were 1.00 for vitamin A and 0.51 for carotene. To be statistically significant at odds of 20 to 1, the F value for either carotene or vitamin A would need to exceed 3.11. On numerous sequences the 15- or 30-day storage samples were higher in carotene or vitamin A than fresh butter. These disturbing results have been reported by other Stations and at this time are not explainable.

No trends were established which indicated any deterioration in the vitamin potency due to holding for one month at 45° to 50° F.

Effect of Long Storage

Much butter goes into cold storage during the season of greatest production. This butter is generally held at 0° to -10° F. for 3 to 6 months and is then brought out during seasonal shortage, whereupon it follows the ordinary marketing channels at relatively high temperatures. Additional samples of butter were secured during April, May, and June from the same churnings used in the original tests. These samples were held in a 0° to -10° F. storage room for 5 months, then removed and placed in a 45° F. refrigerator. This butter was analyzed on the 1st, 15th, and 30th day after removal from the low

Table 4. Effect of 5 month's storage at 0° to -10° F. on carotene and vitamin A content.

	Carotene after		Vitamin A after	
	No months	5 months	No months	5 months
Month	ug./gm.	ug./gm.	ug./gm.	ug./gm.
April	5.0	5.8	7.26	7.34
May	7.3	8.8	7.15	7.00
June	7.5	7.6	6.62	6.75
Average	6.6	7.4	7.01	7.03

temperature room, and the data are presented in table 4.

From the data obtained, no trend indicating that the carotene or vitamin A decreased due to storage at 0° F. or during the succeeding 30-day holding period at 45° F. was established.

The average values secured for the carotene and vitamin A after 5 months storage were actually higher than the original samples. While there were a few tests which might be questioned, most determinations were within the range of experimental error and indicate that the carotene and vitamin A were not adversely affected by 5 months storage at 0° F.

Effect of Holding Cream

Of interest was the somewhat lower potency of the butter from creamery B, the source of the sour cream butter. Although the three creameries in the study were located in the same immediate territory, a study of the data showed a significantly lower carotene and vitamin A content in the butter from this one plant.

While the higher acidity in the cream used in making the samples of butter secured from creamery B might be expected to minimize any reduction in vitamin A potency, a series of tests was conducted to learn if holding cream at fairly high temperatures with accompanying high acid, yeast and mold development, and partial neutralization, might have some influence.

Five tests were completed wherein fresh cream was collected directly from the separator, divided into five lots, and made into butter after different holding periods. Lot 1 was churned immediately without pasteurizing. Lot 2 was pasteurized at 155° F. for 30 minutes, cooled and churned. The remaining lots were held at room temperatures, neutralized, pasteurized and churned at 3-day intervals.

Some of the samples held at 80° to 90° F. developed a very high acidity (1 percent to 1.9 percent) and a yeasty moldy condition. Although the butter was not held for a prolonged storage period, much of the butter made from sour cream partially neutralized was actually in storage for several weeks before being analyzed. An examination of table 6 shows that while there was the same fluctuation in the carotene and vitamin A content experienced in some of the other tests, no significant reduction in vitamin A potency was recorded in the sour cream butter. Since feed and pasture conditions are quite similar in the territory immediately surrounding these plants, the fact that creamery B received cream from direct shippers and cream stations located in various parts of the State possibly not so favored with satisfactory pasture, offers the most logical explanation. The most noticeable spread between the three butters, occurs in the fall and winter months, when many small dairymen make little effort to supply a high quality roughage for their cows.

Table 5. Comparison of carotene, vitamin A and total vitamin A potency of butter from three creameries.

Production period	Carotene mcg./gm.			Vitamin A mcg./gm.			Total vitamin A potency per pound, International Units		
	Creamery			Creamery			Creamery		
	A	B	C	A	B	C	A	B	C
July 1, 1943	7.3	7.1	7.5	5.9	6.6	6.4	17143	18341	18230
August 1	7.7	7.1	8.0	6.4	6.9	6.6	18303	18878	18873
September 1	7.8	7.7	9.2	5.9	5.8	6.2	17484	17079	18981
October 1	7.0	5.2	6.6	6.6	6.6	6.6	18100	16831	17913
November 1	6.1	5.2	5.7	5.8	5.1	5.4	15922	13952	14845
December 1	3.8	3.5	4.0	5.5	4.9	5.3	13549	12311	13388
January 1, 1944	3.7	2.6	4.9	5.2	5.0	5.7	12970	11676	14780
February 1	3.1	2.0	2.0	4.9	4.0	4.6	11887	9292	10569
March 1	2.4	1.2	1.2	6.8	3.7	5.3	14638	8229	11178
April 1	6.0	4.2	4.8	7.3	7.2	7.2	18820	17259	17753
May 1	7.9	6.5	7.4	7.4	6.9	7.1	20393	18434	19528
June 1	7.3	7.5	7.6	6.5	6.5	6.8	18165	18429	19137

Table 6. Effect of holding cream on carotene and vitamin A content of butter.

Production period	Initial acidity	Acidity after neut.	Condition of cream	Temp. held	Condition of pasture	Age of cream	Carotene mcg./gm.	Vitamin A mcg./gm.
Test 1								
8/8	.11	—	Sweet	80-85°	Green	Fresh	8.85	7.52
8/8	.11	—	Sweet	80-85°	Green	Fresh	10.36	7.78
8/11	.93	.25	Sour, yeasty, moldy	80-85°	Green	3 days	11.39	7.66
8/14	1.40	.21	Sour, yeasty, moldy	80-85°	Green	6 days	7.61	7.62
8/17	1.90	.22	Sour, yeasty, moldy	80-85°	Green	9 days	8.70	7.44
Test 2								
8/25	.10	—	Sweet	80-85°	Green	Fresh	8.90	7.66
8/25	.10	—	Sweet	80-85°	Green	Fresh	9.20	7.72
8/28	.90	.25	Sour, yeasty, moldy	80-85°	Green	3 days	10.35	7.37
8/31	1.20	.30	Sour, yeasty, moldy	80-85°	Green	6 days	9.36	8.37
9/4	1.90	.35	Sour, yeasty, moldy	80-85°	Green	9 days	9.05	7.89
Test 3								
10/13	.10	—	Sweet	60-70°	Dry	Fresh	6.38	5.99
10/13	.10	—	Sweet	60-70°	Dry	Fresh	6.80	6.16
10/16	.70	.30	Sour, yeasty, moldy	60-70°	Dry	3 days	6.52	5.97
10/19	.80	.31	Sour, yeasty, moldy	60-70°	Dry	6 days	6.82	6.22
10/22	.85	.25	Sour, yeasty, moldy	60-70°	Dry	9 days	6.59	6.12
Test 4								
11/14	.10	—	Sweet	55-65°	Dry	Fresh	2.80	3.69
11/14	.10	—	Sweet	55-65°	Dry	Fresh	2.61	3.50
11/17	.65	.25	Sour, yeasty, moldy	55-65°	Dry	3 days	2.59	3.68
11/21	.85	.20	Sour, yeasty, moldy	55-65°	Dry	6 days	2.76	3.68
11/24	.95	.25	Sour, yeasty, moldy	55-65°	Dry	9 days	3.09	3.49
Test 5								
Unpasteurized cream								
12/20	.08	—	Sweet	45-60°	Dry	Fresh	3.65	6.13
12/23	.30	—	Sour	45-60°	Dry	3 days	3.46	6.12
12/27	.75	—	Sour	45-60°	Dry	6 days	3.69	6.24
12/30	.79	—	Sour	45-60°	Dry	9 days	3.60	6.36

The Effect of High Temperature Pasteurization on Vitamin A Potency

A high temperature vacuum type pasteurizer was used by creamery B in processing the cream for butter making. Ordinarily the cream was neutralized with sodium carbonate and sodium bicarbonate to between 0.2 percent and 0.3 percent acidity in a forewarmer. It was

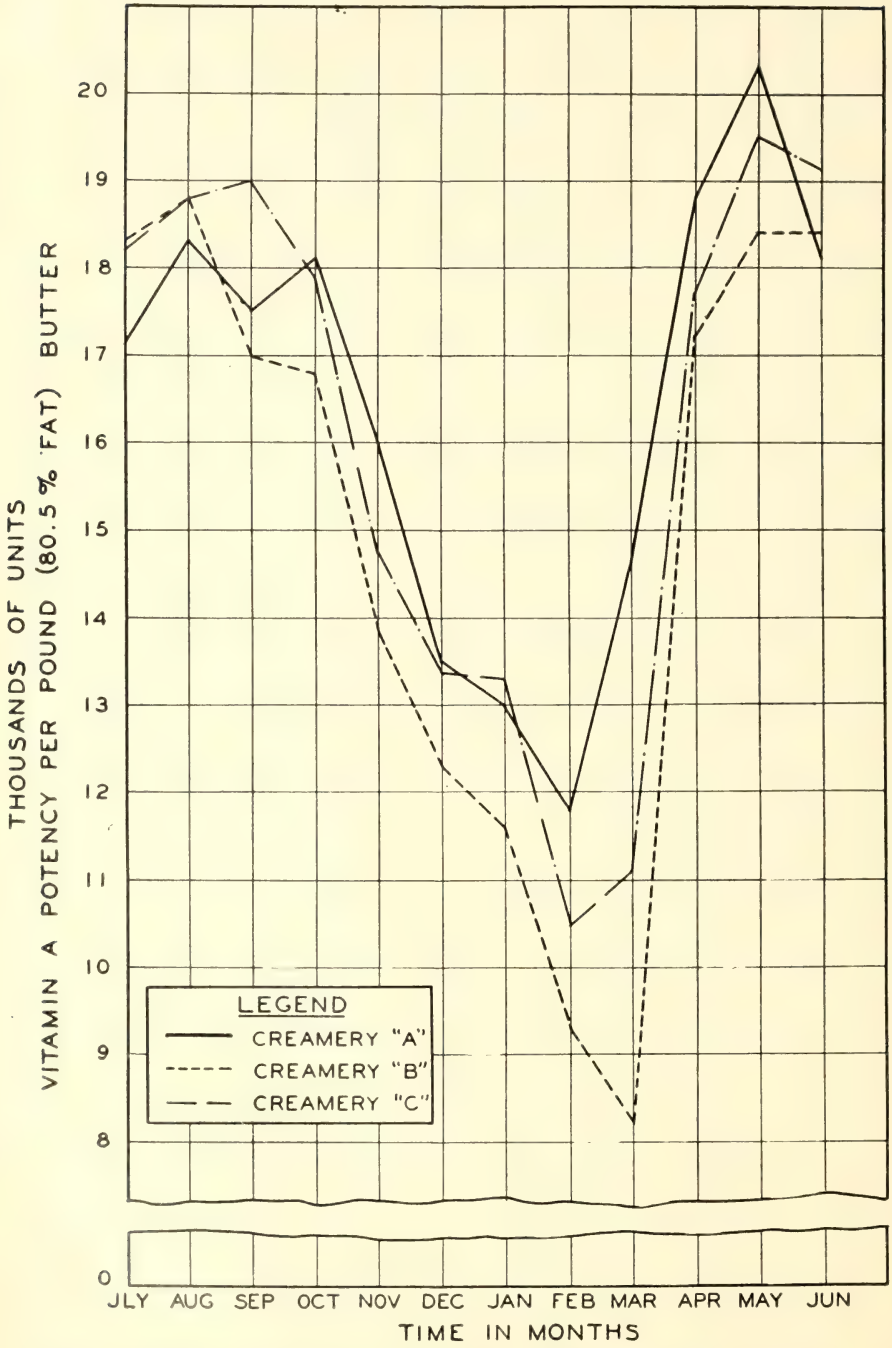

Figure 3. Seasonal vitamin A potency of butter from three Mississippi creameries.

then heated to 90° F. before entering the pasteurizer. The cream was subjected to a steam jet which heated it to 200° to 215° F, then quickly sprayed into a vacuum pan where the temperature dropped to approximately 140° F. This cream then passed over a surface cooler and was cooled to churning temperature. Four check tests were made to learn if this particular process had any effect upon the vitamin A potency of the resulting butter. Samples of the raw cream were taken from the forewarmer before treatment and again off the cooler after being completely processed. The samples of cream were churned and the butter analyzed. The results of this brief study recorded in table 7 indicate that this method of processing had no effect upon the carotene or vitamin A content of the butter studied.

Table 7. Effect of high temperature pasteurization on the vitamin A potency of butter.

		Raw	Pasteurized	Raw	Pasteurized
Production Period	Sample number	Carotene mcg./gm.	Carotene mcg./gm.	Vitamin A mcg./gm.	Vitamin A mg./gm.
April 16, 1945	1	9.76	10.12	8.28	8.71
	2	10.78	10.67	8.68	8.52
May 1, 1945	3	9.41	10.33	6.91	6.79
	4	10.86	10.42	7.38	7.43
Average		10.20	10.38	7.81	7.83

Summary

1. The butter analysed in this study contained approximately 18,000 International Units of vitamin A per pound from April to October inclusive. The butter examined from November through March contained an average of approximately 12,000 International Units per pound.

The similarity of the vitamin A content of butter produced in Mississippi to the national average as determined from results secured by the 19 participating states is most striking. The U. S. Department of Agriculture Miscellaneous Publication No. 571, "Vitamin A in Butter," records that the summer butter averaged 18,000 International Units of vitamin A per pound while winter butter contained approximately 11,200 units per pound.

2. Approximately seventy percent of the butter made in Mississippi is produced during the months of high vitamin A potency.

3. Holding the butter at 45° F. for one month did not lower the carotene or vitamin A content.

4. Holding the butter at 0° F. for 5 months followed by 30 days storage at 45° F. did not lower the carotene or vitamin A content.

5. The development of varying acidities in cream and subsequent neutralization before pasteurization did not lower the carotene or vitamin A content.

6. The use of high temperature vacuum type of pasteurization did not affect the carotene or vitamin A content.

7. The carotene content of the butter examined showed a much greater seasonal variation than the vitamin A content.

Discussion

The contribution of vitamin A through the medium of dairy products is of major nutritional importance to the consuming public. Figure 1 shows that the lowest level of vitamin A potency of milk products occurs in the winter months when other foods comprising the human diet are also low in vitamin A. It would be most desirable if the vitamin A content of winter butterfat could be held at a higher level.

Koehn, of the Alabama Station found

that the milk from cows placed on a temporary pasture of Abruzzi Italian rye, crimson and white Dutch clover in February, increased in 2 weeks time to a vitamin A content equal to that of good summer milk and remained at that level until the permanent pastures were ready for spring grazing. An equal increase in vitamin A can be expected from the grazing of any other growing cover crop.

Oats, wheat and vetch, in particular, have become popular in many sections of Mississippi. The Dairy Department of Mississippi State College used a mixture of 1½ bushels oats, ½ bushel wheat, and 15 pounds vetch to the acre; more recently the amount of seed has been increased to 2 bushels oats, 1 bushel wheat, and 15 pounds vetch.

While, from the standpoint of the nutritionist, this increase in vitamin A in dairy products is of particular importance, the actual benefits of direct value to the dairyman extend far beyond the improvement in the quality of milk.

Financial Returns

Numerous tests run by the Mississippi Station have shown that grazing winter cover crops is profitable, and consequently cover crops grazing has been practiced by the Dairy Department for the past 20 years. In a specific test reported by J. S. Moore in the December 1943 Farm Research, 12 acres were disked and planted to oats and vetch in September. By November 10th there was a stand of oats averaging 8 to 15 inches in height. While the dairy herd was already on full winter ration, 52 cows and 18 heavy springers were turned on this field for 15 days. The yield of milk increased 16.3 precent the first week and 24.6 percent during the second week. The value of the increased production, together with silage saved and $31.50 credit for the physical improvement of the springers, were given a minimum estimate of $176.55 that could be attributed to the first 15 days grazing. Ordinarily one or two more grazing periods can be expected depending upon the season.

Feed

Moore reports another test wherein 80 to 90 acres were planted to a mixture of oats, wheat and vetch. By the end of December sufficient grazing had been obtained from these crops to pay all costs of seed, preparation of land, and planting. One field was not grazed after January 1st. The seed was allowed to ripen and the crop was harvested for feed, yielding 1,678 pounds of grain and 2,425 pounds of straw per acre. To secure this same feed value from corn as a grain crop would require a yield of about 30 bushels of corn per acre. The winter grazing crop was grown when the land would otherwise have been idle, required no work after planting, and furnished a good cover crop which protected the soil from erosion during the winter months. A yield of 1¼ tons of hay per acre was secured after fall and early spring grazing. This crop was removed early enough to plant corn. Where the grain was allowed to mature it was followed with sorghum for silage, sagrain for grain or silage, and soybeans for hay.

Green Manure

In the above test a portion of the crop was disked in for soil building. This was done on March 24th, after taking the cows off on March 15th, and amounted to about 5,645 pounds of green manure to the acre. Some of the phosphorus and potash of the soil was probably conserved and changed to a more easily assimilated form, and it was estimated 16½ additional pounds of nitrogen were added to the soil together with organic matter. This organic matter improves the physical condition of the soil, permits greater infiltration of rainfall, and prevents or greatly diminishes soil loss due to water erosion at the most critical period of the year.

Erosion

Russell Woodburn reports that tests at the Mississippi Station show an average loss of 83 tons of soil per acre on a bare plot on a 9 percent slope over a 3-year period. A maximum loss of 141 tons per acre or almost one inch of soil occurred in 1944 due to the severe rainfall. A cotton plot nearby on a slope of 10 percent. with winter vetch cover, lost 25 tons per acre in 1944. This loss was almost entirely during the cotton season from April 1 to October 1. Of further interest is the fact that turning under vetch on other experimental plots permitted ten times more soil loss during the 1944 cotton season than disking in. While the plot having the disked vetch lost 2.3 tons of soil per acre from April to October, the bare plot lost 83 tons during the same period.

Physical Condition of the Cow

Kuhlman, of the Oklahoma Station, states that many dairy cattle in the South receive rations so low in carotene that normal functional performance cannot be attained. This is due to the feeding of large quantities of low grade hay, cottonseed hulls, and lack of good silage. The Oklahoma Station states that 40 to 45 micrograms of carotene per pound body weight is about the minimum amount which will meet the daily requirements of cows of the Jersey breed, permit normal calving and the initiation of a normal lactation period. When the carotene intake fell below this point during the last 90 days before calving, many of the calves were either dead or very weak at birth, the cows developed symptoms of vitamin A deficiency, and some indication of a shortened gestation period was noted.

Acknowledgments

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Cotton Variety Tests
in the
Yazoo-Mississippi Delta
1943-45

By
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Delta Branch Experiment Station, Stoneville

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

Cotton Variety Tests in the Yazoo-Mississippi Delta, 1943-45

By **J. WINSTON NEELY** and **SIDNEY G. BRAIN**
Delta Branch Experiment Station, Stoneville

For many years the Delta Branch Station has been testing varieties of cotton at Stoneville and on selected plantations in other representative sections of the Yazoo-Mississippi Delta in an effort to evaluate the performance of the various cottons under as nearly as possible the same conditions that they are to be grown by Delta planters.

It has been the policy of the station to adapt the variety tests to the current needs of producers, buyers, spinners, weavers, and oil-mill operators for information relative to the characteristics of varieties. During the time that the boll weevil was first becoming a factor in production, information was obtained regarding the relative boll-weevil tolerance of cotton varieties because of earliness. When pathogenic wilt became a production factor in some parts of the Delta, information was provided regarding the relative wilt resistance of the different varieties.

At the present time cotton mills are paying a great deal of attention to tensile strength of fiber and fiber length uniformity, since these characteristics, along with length, give an indication of the resulting manufacturing quality of the cotton. The current report is the third from the Delta Station in which tensile strength of fiber and fiber length uniformity for each of the varieties grown at each of the locations have been reported.

As additional information relative to the characteristics of cotton varieties is required, the tests will be planned to supply as much of this information as possible.

During the past 3 years, the following characteristics of the most commonly planted varieties have been determined: (1) Yield of seed cotton, (2) yield of lint, (3) gin turn-out, (4) staple length, (5) size of boll, (6) earliness, (7) fiber tensile strength, (8) length uniformity of fiber, and (9) money value per acre.

The yields of seed cotton are based upon the weights harvested from ten, one-row plots at each location each season.

The yields of lint are based upon the respective yields of seed cotton and gin turn-outs.

Gin turn-out values were determined by ginning ten, 100-boll samples which were picked from each variety at each location during each of the three seasons.

The staple lengths of each variety at each location were determined by classers of the Staple Cotton Cooperative Association, Greenwood, Mississippi, and of the Greenwood office of the Board of Cotton Examiners, Production and Marketing Administration, of the U. S. Department of Agriculture.

The sizes of boll are based upon the average weight of ten, 100-boll samples from each variety at each location.

The percentage of cotton obtained from the first picking, which is considered a measure of earliness, was determined by dividing the weight of the first picking by the weight of the total production.

The fiber tensile strength and the length uniformity of fiber were determined in the Stoneville Fiber Laboratory of the Production and Marketing Administration.

The money values per acre are based upon: (1) Yields of seed and lint, (2)

Table 1. Stoneville cotton variety test, 1945.

Variety	Yield per acre		Gin turnout	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	2872	948	33.0	35.7	67.5	33.4	83,600	83.0	304	291	252
Bobshaw 1	2928	1016	34.7	34.9	66.5	27.1	82,800	82.7	310	293	261
Coker 100-9	2865	1043	36.4	36.2	66.5	23.9	81,800	80.0	341	312	266
Coker 100-Staple Str. 1	2821	990	35.1	36.6	65.0	22.9	78,900	80.3	335	306	257
Delfos 444	2975	890	29.9	36.9	78.9	23.2	74,500	79.7	320	292	244
Delfos 531C	2601	843	32.4	37.0	74.7	33.6	78,300	78.9	303	277	230
Delfos 651	2659	877	33.0	36.9	72.6	34.4	77,400	79.7	313	285	238
Delfos 9169	2947	1020	34.6	36.3	63.5	28.2	78,000	80.5	345	317	269
Deltapine 14	2668	1025	38.4	34.9	71.4	22.4	77,700	83.6	308	290	254
Miller	3010	1072	35.6	32.8	59.3	25.9	76,900	85.5	309	296	264
Stoneville 2B	3049	1061	34.8	35.6	60.7	23.7	82,800	82.1	341	316	275
Wilds 17	2319	730	31.5	40.6	64.7	17.2	89,900	81.3	300	271	204
Dif. barely significant	204	73	.7	.6	1.9	4.8	1,700	1.8	26	24	19
Dif. highly significant	270	97	.9	.8	2.6	6.4	2,300	2.4	35	32	25

staple lengths, and (3) seed grades. The values for three grades—Middling, Strict Low Middling, and Low Middling—are given. The average prices for cotton of the respective grades and several lengths for 10 weeks of the 1945 marketing season in Memphis were used. The seed were evaluated on a basis of $56 per ton, with premiums and discounts in accordance with official standards for grading cottonseed set up by the U. S. Department of Agriculture. The seed analyses were made in the Stoneville Laboratory of the Production and Marketing Administration of the U. S. Department of Agriculture.

The current report is divided into two parts: (1) The 1945 tests, and (2) the 1943 to 1945 tests.

Results of the 1945 Tests

During the 1945 season the Delta Branch Experiment Station conducted cotton variety tests at the following locations in the Yazoo-Mississippi Delta: Stoneville, Jonestown, Money, Heathman, Valley Hill, Yazoo City, and Kelso.

Excessive amounts of rainfall during the planting, growing, and harvesting seasons occurred at all locations.

Stoneville Test

The Stoneville test was located at the Delta Branch Experiment Station and was conducted in cooperation with the late J. W. Whitaker, county agent of Washington County. The soil is a sandy loam, typical of banks along upper Deer Creek. A nitrogenous fertilizer was "bedded on" about 2 weeks before planting. The test was planted on April 27. The first picking was made on September 18, and the second and third pickings were made on October 11 and December 7, respectively. Results of the 1945 Stoneville tests are given in table 1.

When comparisons are based upon Middling grade, the following varieties were leading money-value producers: Delfos 9169, Coker 100-9, Stoneville 2B, Coker 100-Staple Strain 1, and Delfos 444. If comparisons are made on the basis of Strict Low Middling grade, the leading varieties are Delfos 9169, Stoneville 2B, Coker 100-9, Coker 100-Staple Strain 1, Miller, and Bobshaw 1. The following varieties are leading money-value producers when comparisons are

Table 2. Jonestown cotton variety test, 1945.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint							Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1623	489	30.1	36.5	69.8	76.1	83,300	76.5	172	157	134
Bobshaw 1	1627	513	31.5	35.3	65.9	72.1	82,600	76.2	163	153	136
Coker 100-9	1158	395	34.1	36.5	72.4	79.2	81,900	71.3	131	120	101
Coker 100-Staple Str. 1	1419	468	33.0	37.1	70.3	70.9	80,900	72.2	164	149	123
Delfos 444	1365	366	26.8	37.4	79.2	75.9	74,400	73.6	138	126	104
Delfos 531C	1439	445	30.9	36.9	74.5	76.1	78,300	72.7	159	145	122
Delfos 651	1400	430	30.7	36.6	71.0	77.8	78,400	73.5	151	138	118
Delfos 9169	1591	522	32.8	35.9	63.9	72.3	77,400	74.4	173	160	139
Deltapine 14	1290	490	38.0	35.6	76.8	64.3	77,900	77.5	151	140	122
Miller	1564	533	34.1	33.1	58.5	65.8	77,000	77.8	155	148	132
Stoneville 2B	1373	450	32.8	35.5	62.2	67.7	80,400	75.0	144	135	118
Wilds 17	901	266	29.5	41.1	66.2	42.4	86,500	75.4	111	100	75
Dif. barely significant	185	62	.8	.5	2.0	6.7	2,000	1.7	21	19	16
Dif. highly significant	245	83	1.0	.7	2.6	8.8	2,700	2.3	28	25	21

made on the basis of Low Middling: Stoneville 2B, Delfos 9169, Coker 100-9, Miller, Bobshaw 1, and Coker 100-Staple Strain 1.

Jonestown Test

The Jonestown test was conducted in cooperation with Carey Cocke, Jr., farm operator, and Harris Barnes, county agent of Coahoma County. The test is located on the Eagle Nest Plantation west of Jonestown. The soil is a sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" and the test planted on May 11. The first and second pickings were made on October 18 and February 21, respectively. The plants were rank. There was a light boll-weevil infestation and considerable boll rot. Pathogenic wilt killed a few plants but probably was of no consequence. There was some falling out of cotton between the first and last pickings, but very little difference in this respect between varieties was noted. The results of the tests conducted at Jonestown in 1945 are given in table 2.

The upper money value producing group includes Delfos 9169, Bobdel, Coker 100-Staple Strain 1, Bobshaw 1, Delfos 531C, and Miller when comparisons are made on the basis of Middling grade. Delfos 9169, Bobdel, Bobshaw 1, Coker 100-Staple Strain 1, Miller, and Delfos 531C are leading money-value producers in the Strict Low Middling comparisons. Delfos 9169, Bobshaw 1, Bobdel, Miller, and Coker 100-Staple Strain 1 lead in regard to money value per acre when comparisons are based upon the Low Middling grade.

Money Test

In cooperation with H. L. Gary, president of Wildwood, Incorporated, and J. S. McBee, county agent of Leflore County, a test was conducted near Money on the east banks of the Tallahatchie River. The soil is a fine, sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" before planting. The test was planted on April 19. "Damping off" of seedlings resulted in irregular stands, but apparently none of the varieties were discriminated against because of poor stands. The first picking was made on September 28 and the second picking on November 23. The results of the 1945 Money tests are given in table 3.

Table 3. Money cotton variety test, 1945.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1950	597	30.6	35.0	69.2	61.7	79,300	77.6	192	181	161
Bobshaw 1	2204	734	33.3	34.9	67.8	61.6	75,000	77.7	226	214	190
Coker 100-9	1977	700	35.4	35.4	68.7	58.7	76,400	75.2	216	201	177
Coker 100-Staple Str. 1	2141	728	34.0	36.1	67.9	56.3	73,100	74.9	239	220	189
Delfos 444	2301	656	28.5	35.7	75.4	62.4	68,300	75.0	223	208	182
Delfos 531C	2175	689	31.7	35.9	72.1	64.8	72,800	73.8	232	215	187
Delfos 651	2183	694	31.8	36.2	69.9	63.5	74,900	73.4	238	219	189
Delfos 9169	2014	677	33.6	35.4	60.3	65.4	73,900	75.8	217	202	178
Deltapine 14	1987	761	38.3	34.7	73.7	50.8	73,400	77.8	224	212	187
Miller	2086	738	35.4	32.8	60.9	57.6	70,200	79.9	214	205	182
Stoneville 2B	2323	783	33.7	35.0	60.8	60.1	76,800	75.8	241	228	203
Wilds 17	1547	463	29.9	39.9	66.6	47.3	83,800	76.9	188	170	131
Dif. barely significant	202	68	.6	.4	1.8	5.1	2,100	1.3	22	20	18
Dif. highly signifilant	268	90	.8	.6	2.4	6.7	2,800	1.7	29	27	23

Stoneville 2B, Coker 100-Staple Strain 1, Delfos 651, Delfos 531C, Bobshaw 1, Deltapine 14, and Delfos 444 lead the test in money value produced on the basis of Middling and Strict Low Middling comparisons. Stoneville 2B, Bobshaw 1, Coker 100-Staple Strain 1, Delfos 651, Delfos 531C, and Deltapine 14 are leading money-value producers in the Low Middling comparisons.

Heathman Test

The Heathman test, in Sunflower County, was conducted in cooperation with Roy Kuykendall, general manager

Table 4. Heathman cotton variety test, 1945.

	Yield per acre								Total money value		
Variety	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	2102	660	31.4	36.1	63.6	67.1	80,200	78.3	225	207	179
Bobshaw 1	2281	746	32.7	35.6	61.9	54.7	78,600	78.9	242	224	196
Coker 100-9	2199	774	35.2	36.3	64.1	59.5	79,000	76.3	255	234	198
Coker 100-Staple Str. 1	2522	847	33.6	37.6	61.4	53.2	75,300	78.2	305	277	224
Delfos 444	2608	759	29.1	37.2	69.3	61.4	70,900	78.7	282	257	213
Delfos 531C	2417	776	32.1	37.6	66.2	61.4	75,100	75.4	286	260	212
Delfos 651	2270	722	31.8	36.8	65.8	62.3	74,700	77.3	257	235	197
Delfos 9169	2343	790	33.7	36.4	56.7	60.5	75,300	77.8	269	246	210
Deltapine 14	2052	802	39.1	35.0	67.2	51.9	74,200	79.4	236	223	196
Miller	2144	765	35.7	33.0	54.4	55.9	75,000	81.2	221	212	188
Stoneville 2B	2373	795	33.5	36.0	56.6	59.5	77,700	76.1	263	242	210
Wilds 17	1767	523	29.6	40.9	63.3	51.5	85,900	76.3	218	196	147
Dif. barely significant	221	75	.6	.6	1.6	5.1	2,200	1.9	27	24	20
Dif. highly significant	293	99	.8	.8	2.1	6.7	2,900	2.6	36	32	26

of Bobshaw Chemurgic Plantation, and H. A. Carpenter, county agent. The field is located on Highway 82. The soil is a light colored, well drained, silt loam. A nitrogenous fertilizer was "bedded on" before planting. The test was planted on May 5. Stands were irregular due to "damping off," but apparently none of the varieties were discriminated against because of poor stands. Boll-weevil infestations were heavy. The first picking was made on September 24 and the second picking on November 28. The results of the Heathman test are given in table 4.

When comparisons were made upon the basis of Middling or Strict Low Middling grades, Coker 100-Staple Strain 1, Delfos 531C, and Delfos 444 were leading money-value-per-acre producers. Coker 100-Staple Strain 1, Delfos 444, Delfos 531C, Delfos 9169, and Stoneville 2B produced significantly higher money values per acre than did the other varieties when comparisons were based upon Low Middling grade.

Valley Hill Test

In cooperation with L. S. Hemphill, landowner, and R. A. Cooper, county agent, a test was conducted at Valley Hill in Carroll County about 6 miles east of Greenwood on Highway 82. The test is on the eastern border of the Delta. The surface soil is a light colored, well drained, silt loam made up of outwash from the hills. A nitrogeous fertilizer was "bedded on" before planting. The test was planted on May 23. An earlier planting on April 20 failed to give sufficient stands. Pathogenic wilt was very bad. Delfos 651, Delfos 444, Delfos 531C, Coker 100-Staple Strain 1, and Coker 100-9 were the most susceptible varieties. Miller and Bobshaw 1 were the most resistant varieties. Boll-weevil infestations were very heavy, and losses due to weevil were of some consequence, particularly in the late varieties. The test was picked on October 19. Earliness data are not available. The results of the 1945 Valley Hill test are given in table 5.

Delfos 9169, Bobdel, Miller, Bobshaw 1, and Coker 100-Staple Strain 1 were

Table 5. Valley Hill cotton variety test, 1945.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Fiber tensile strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint						Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1501	444	29.6	35.1	65.5	79,100	77.9	143	135	121
Bobshaw 1	1428	456	31.9	34.3	64.7	78,400	78.2	140	133	118
Coker 100-9	790	269	34.1	35.6	66.0	77,400	72.0	84	78	68
Coker 100-Staple Str. 1	1231	409	33.2	36.1	65.3	75,800	74.6	135	124	106
Delfos 444	1205	329	27.3	36.4	75.4	68,900	76.7	118	109	93
Delfos 531C	782	239	30.5	35.9	75.7	74,900	72.2	81	75	65
Delfos 651	973	298	30.6	35.9	68.8	76,100	74.8	101	93	81
Delfos 9169	1454	475	32.7	35.4	62.0	74,300	76.0	152	142	126
Deltapine 14	1006	377	37.5	35.0	73.1	75,500	77.8	113	106	93
Miller	1411	492	34.9	32.5	57.4	74,600	80.4	141	136	121
Stoneville 2B	1274	417	32.7	34.8	59.8	77,800	75.5	128	121	108
Wilds 17	873	254	29.1	39.8	66.2	87,200	75.3	99	90	69
Dif. barely significant	173	57	.7	.4	2.0	2,100	1.5	18	17	15
Dif. highly significant	228	76	1.0	.6	2.7	2,800	2.0	24	23	20

Table 6. Yazoo City cotton variety test, 1945.

Variety	Yield per acre: Seed cotton	Yield per acre: Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value: Mid-dling	Total money value: Strict Low Mid-dling	Total money value: Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1790	551	30.8	35.6	68.8	85.8	77,400	77.9	187	174	153
Bobshaw 1	1913	626	32.7	35.3	68.1	84.1	75,300	77.4	207	194	171
Coker 100-9	1644	579	35.2	35.9	70.6	85.0	76,500	76.1	187	173	149
Coker 100-Staple Str. 1	1888	648	34.3	36.5	68.5	83.5	73,200	76.9	214	196	164
Delfos 444	2091	594	28.4	36.4	76.7	87.5	69,400	77.8	204	188	160
Delfos 531C	1908	605	31.7	36.3	75.1	88.8	73,000	75.1	201	184	158
Delfos 651	1828	578	31.6	36.4	70.7	86.5	74,000	75.8	200	183	157
Delfos 9169	2017	670	33.2	35.4	64.0	86.8	73.400	75.7	213	198	174
Deltapine 14	1877	717	38.2	34.7	73.3	80.4	71,700	79.4	209	198	175
Miller	1795	623	34.7	32.9	61.2	80.8	69,600	80.9	177	170	152
Stoneville 2B	1903	632	33.2	35.5	61.8	87.9	77,200	75.7	200	187	164
Wilds 17	1377	410	29.8	40.1	64.8	82.2	85,000	76.4	185	167	128
Dif. barely significant	178	62	.7	.5	1.9	3.7	1,500	1.8	23	21	17
Dif. highly significant	235	82	1.0	.6	2.5	4.9	2,000	3.2	31	28	23

leading money-value producers when comparisons were made upon the basis of Middling grade.

When comparisons were made on the basis of Strict Low Middling or Middling grades, Delfos 9169, Bobdel, Miller, and Bobshaw 1 were leading money-value-per-acre producers.

Yazoo City Test

The Yazoo City test was conducted on the Marx Schaefer farm 3 miles west of Yazoo City in cooperation with Mr. Schaefer and with A. R. Ruby, county agent of Yazoo County. The soil is a fine sandy loam and is well drained. A nitrogenous fertilizer was "bedded on" and the test planted on April 12. There was considerable "damping off" of seedlings, but the stands were fairly good. The plants grew tall, and the foliage was very heavy. Boll rot and boll-weevil infestations were very bad. The test was picked on September 26 and again on November 29. Results of the Yazoo City test are given in table 6.

Leading money-value producers were Coker 100-Staple Strain 1, Delfos 9169, Deltapine 14, Bobshaw 1, Delfos 444, Delfos 531C, Delfos 651, and Stoneville 2B when comparisons are made on the basis of Middling grade. Delfos 9169, Deltapine 14, Coker 100-Staple Strain 1, Bobshaw 1, Delfos 444, Stoneville 2B, Delfos 531C, and Delfos 651 lead in regard to money value per acre when comparisons are based upon Strict Low Middling grade. When comparisons are based upon Low Middling grade, the following varieties were the leading money-value producers: Deltapine 14, Delfos 9169, Bobshaw 1, Coker 100-Staple Strain 1, Stoneville 2B, Delfos 444, and Delfos 531C.

Kelso Test

The Kelso test was conducted in cooperation with James Hand of Kelso Plantation and C. L. Cary, county agent of Sharkey County. It is located on the Sharkey-Issaquena county line 11 miles south of Cary on Highway 61. The soil is a sandy loam and is well drained. The test was planted in check rows on April 17. The rows were 40 inches apart each way. Six plants were left in each

Table 7. Kelso cotton variety test, 1945.

Variety	Yield per acre: Seed cotton	Yield per acre: Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Fiber tensile strength	Fiber length uni-formity	Total money value: Mid-dling	Total money value: Strict Low Mid-dling	Total money value: Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1385	414	29.9	35.4	70.0	75,100	76.3	135	127	112
Bobshaw	1439	435	30.2	34.7	68.2	73,300	77.6	137	130	116
Coker 100-9	1389	454	32.7	35.9	72.0	74,500	75.8	148	136	118
Coker 100-Staple Str. 1	1363	425	31.2	36.4	69.5	71,600	74.0	146	134	114
Delfos 444	1615	417	25.8	36.2	79.1	67,700	74.3	150	138	120
Delfos 531C	1483	430	29.0	36.3	73.6	70,800	73.5	152	140	121
Delfos 651	1468	421	28.7	36.1	72.9	71,300	74.2	147	136	118
Delfos 9169	1390	441	31.7	35.3	63.1	69,900	74.6	142	133	118
Deltapine 14	1179	428	36.3	35.2	74.7	70,700	77.6	130	122	108
Miller	1161	383	33.0	32.9	63.3	68,300	79.6	113	109	97
Stoneville 2B	1513	474	31.3	35.2	61.8	74,600	75.1	152	143	126
Wilds 17	990	276	27.9	40.0	66.2	81,900	76.8	114	103	79
Dif. barely significant	122	39	.6	.4	2.0	1,900	1.7	12	12	10
Dif. highly significant	162	51	.8	.5	2.6	2,400	2.2	16	15	13

hill. The plants grew very tall, and the foliage was very heavy. Boll-weevil infestations were bad. The entire production was picked on October 16. Earliness data were not obtained. Results of the 1945 Kelso test are given in table 7.

Delfos 531C, Stoneville 2B, Delfos 444, Cooker 100-9, Delfos 651, Coker 100-Staple Strain 1, and Delfos 9169 were leading money-value-per-acre producers when comparisons were made on the basis of Middling and Strict Low Middling grades. When comparisons were made on the basis of Low Middling grade, Stoneville 2B, Delfos 531C, Delfos 444, Coker 100-9, Delfos 651, Delfos 9169, and Bobshaw 1 were leading money-value-per-acre producers.

Results From 2- and 3-Year Variety Studies

Seasonal conditions have a marked effect upon the yield and other characteristics of cotton varieties. For this reason, data from a variety study conducted for only one season are probably not indicative of long-time performance. The results obtained by averaging the data obtained by conducting variety tests over a period of years provide much more useful information.

Variety tests similar to those described above were conducted during the 3 years 1943 to 1945 at Stoneville, Money, Heathman, Valley Hill, and Yazoo City, and during the years 1944 and 1945 at Kelso. Only 10 varieties were common to tests grown during all of the seasons.

Methods of conducting the tests, collecting samples, and analyzing data are the same as outlined for the 1945 tests. Dates of planting and picking at the different locations in 1943 and 1944 are given in bulletins 398 and 416 of the Mississippi Agricultural Experiment Station. The dates for the 1945 tests were given earlier in this report.

The 1943 and 1944 growing seasons in the Yazoo-Mississippi Delta were characterized by marked deficiencies of soil moisture during the boll-maturation period. The staple lengths of all varieties were shorter than normal, and the lengths of Bobdel, Coker 100, and the Delfos strains were affected more by dry

Table 8. Yield and other data from cotton variety tests—Stoneville—3 year averages, 1943-45.

Variety	Yield per acre								Total money value		
	Seed cotton	Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	2335	754	32.3	35.4	73.2	56.4	87,100	79.7	194	180	152
Bobshaw 1	2371	830	35.0	34.4	71.7	49.6	87,000	80.2	203	190	163
Coker 100*	2346	852	36.3	35.3	72.1	46.7	83,400	76.4	218	201	171
Delfos 444	2387	702	29.4	36.5	84.5	51.0	78,500	78.1	199	178	144
Delfos 531C	2306	749	32.5	36.2	79.8	52.6	80,200	74.8	207	186	154
Delfos 651	2321	771	33.2	36.0	78.2	51.7	80,700	75.6	209	189	158
Deltapine 14	2333	931	39.9	34.6	77.2	42.9	79,400	80.3	229	214	184
Miller	2451	885	36.1	31.9	63.2	50.1	80,900	82.5	206	196	170
Stoneville 2B	2614	920	35.2	35.2	64.8	45.8	83,600	77.6	233	216	185
Wilds 15**	1978	625	31.6	40.2	74.2	38.1	92,500	76.1	213	187	132

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

weather than were the lengths of the slower maturing varieties. Excessive amounts of rainfall during the planting, growing, and harvesting seasons occurred at all locations in 1945.

The yields of seed cotton and lint, gin turn-out, staple length, boll size, earliness, fiber tensile strength, uniformity of fiber length, and total money values, based upon Middling, Strict Low Middling, and Low Middling, are given in tables 8 to 13 for the respective locations.

The yields of seed cotton were determined by averaging the seed cotton yields obtained during each of the seasons that the tests were conducted at a given location.

The yield of lint was obtained by multiplying the average gin turn-out by the average yield of seed cotton per acre.

The gin turn-out data presented in each table were obtained by determining the mean lint percentages of 30 samples for each variety for the 3-year tests and of 20 samples for the 2-year tests.

The staple length, the number of bolls required for a pound of seed cotton, the percent of seed cotton picked during the first picking, the fiber tensile strength, and the fiber length uniformity ratio, were determined by averaging the values obtained for each variety during the seasons that the tests were conducted at a given location.

The total money values per acre were obtained by using the average yields of seed cotton and lint, the average staple length for the 2- or 3-year period, the average seed grade for 1944 and 1945, and the price of lint for the respective grades and lengths for 1945.

During the 3-year period 1943 to 1945, the leading money value producing varieties at Stoneville were Stoneville 2B, Deltapine 14, and Coker 100.

At Money the leading money-value producers were Stoneville 2B, Deltapine 14, and Bobshaw 1.

The leading money-value producers at Heathman, based on the 3-year averages, were Stoneville 2B and Deltapine 14.

Stoneville 2B, Miller, Bobshaw 1, and Deltapine 14 were leading money-value producers at Valley Hill during the 3-year period.

The total money values produced by Deltapine 14, Stoneville 2B, and Bobshaw 1 were higher than the values produced by the other seven varieties at Yazoo City during the years 1943 to 1945.

At Kelso the leading money-value producing varieties during the 2-year period 1944 to 1945 were Delfos 531C, Coker 100, and Stoneville 2B.

Table 9. Yield and other data from cotton variety tests—Money—3-year averages, 1943-45.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint							Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1870	587	31.4	35.4	73.2	65.2	84,100	77.6	151	140	118
Bobshaw 1	2059	698	33.9	34.6	70.4	60.2	82,300	77.7	171	161	138
Coker 100*	1748	621	35.5	35.3	72.2	59.2	79,100	75.2	159	146	125
Delfos 444	1988	567	28.5	36.5	81.3	61.8	74,500	75.0	161	144	117
Delfos 531C	1850	596	32.2	35.8	77.9	65.2	78,700	73.8	159	144	121
Delfos 651	1859	602	32.4	36.0	75.7	63.5	79,000	73.4	164	147	123
Deltapine 14	1830	723	39.5	34.5	77.0	52.4	76,800	77.8	177	166	142
Miller	1885	671	35.6	32.3	62.5	62.0	78,000	79.9	157	149	129
Stoneville 2B	2112	720	34.1	35.1	64.8	60.4	81,300	75.8	181	168	144
Wilds 15**	1407	428	30.4	40.1	72.5	53.1	89,400	76.9	145	128	91

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

Table 10. Yield and other data from cotton variety tests—Heathman—3-year averages, 1943-45.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint							Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1547	501	32.4	35.1	79.7	72.7	84,200	76.2	126	117	100
Bobshaw 1	1735	599	34.5	34.1	77.1	68.9	84,500	78.2	145	136	117
Coker 100*	1596	575	36.0	34.7	81.0	68.3	80,700	74.3	142	133	114
Delfos 444	1763	518	29.4	35.9	87.8	75.3	76,500	75.4	140	126	106
Delfos 531C	1635	538	32.9	35.7	85.7	73.7	78,800	73.0	142	130	109
Delfos 651	1615	531	32.9	35.3	83.2	72.8	78,700	74.1	136	125	107
Deltapine 14	1555	627	40.3	33.9	83.4	61.8	76,200	77.6	151	142	122
Miller	1687	611	36.2	32.2	66.3	69.3	79,100	79.3	143	136	118
Stoneville 2B	1852	639	34.5	34.6	69.9	69.9	80,500	74.9	157	147	126
Wilds 15**	1378	438	31.8	39.5	79.1	56.0	87,800	72.8	145	129	92

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

Table 11. Yield and other data from cotton variety tests—Valley Hill—3-year averages, 1943-45.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking ***	Fiber tensile strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint							Mid-dling	Strict Low Mid-dling	Low Mid-dling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1145	356	31.1	34.8	76.0	72.9	82,500	78.3	88	82	71
Bobshaw 1	1148	383	33.4	34.1	75.6	67.7	82,400	78.2	93	87	75
Coker 100*	879	312	35.5	34.7	75.5	72.9	77,600	73.7	77	72	62
Delfos 444	1023	293	28.6	35.8	85.1	71.9	71,700	76.4	78	71	60
Delfos 531C	874	279	31.9	35.5	83.6	67.5	76,500	73.3	73	67	56
Delfos 651	983	318	32.3	35.1	80.6	63.6	77,400	74.9	80	74	64
Deltapine 14	952	367	38.6	34.6	82.7	51.3	76,900	78.5	90	84	72
Miller	1154	413	35.8	31.9	66.8	62.1	77,100	80.5	96	91	79
Stoneville 2B	1172	400	34.1	34.4	69.1	61.2	79,200	75.7	98	92	79
Wilds 15**	792	238	30.0	39.2	78.3	60.4	87,400	74.3	78	69	50

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.
***Based on 1944 data only.

Table 12. Yield and other data from cotton variety tests—Yazoo City—3-year averages, 1943-45.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Fiber tensile strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1880	603	32.1	35.0	76.9	77.4	82,500	77.8	150	140	120
Bobshaw 1	2138	748	35.0	34.2	74.9	74.0	81,000	79.2	181	171	146
Coker 100*	1852	678	36.6	35.0	77.8	73.9	78,300	75.4	168	157	135
Delfos 444	2001	590	29.5	35.8	86.8	76.4	74,000	77.0	158	143	120
Delfos 531C	1975	654	33.1	35.6	83.2	77.5	77,500	73.6	172	157	133
Delfos 651	2019	668	33.1	35.3	79.9	76.1	76,900	75.1	170	157	134
Deltapine 14	2070	832	40.2	34.0	81.8	70.3	75,600	79.3	200	189	162
Miller	2020	737	36.5	31.9	65.3	68.5	76,000	81.0	172	163	142
Stoneville 2B	2165	756	34.9	34.6	68.8	74.4	80,200	76.2	186	174	149
Wilds 15**	1677	522	31.1	39.9	75.2	64.6	88,000	74.1	175	156	110

*Coker 100-7 in 1943; Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 15 in 1943; Wilds 16 in 1944; Wilds 17 in 1945.

Table 13. Yield and other data from cotton variety tests—Kelso—2-year averages, 1944-45.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking ***	Fiber tensile strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict Low Middling	Low Middling
	Lbs.	Lbs.	Pct.	1/32 in.	Bolls	Pct.	Lbs./sq.in.	Ratio	Dols.	Dols.	Dols.
Bobdel	1650	515	31.2	35.7	73.0	81.9	77,900	77.6	137	124	105
Bobshaw 1	1798	588	32.7	34.7	69.5	81.4	77,400	78.9	145	136	117
Coker 100*	1763	615	34.9	35.4	73.1	76.4	76,000	76.5	159	146	124
Delfos 444	1860	510	27.4	36.4	83.1	70.2	69,900	75.9	143	129	105
Delfos 531C	1885	590	31.3	36.2	76.7	82.5	73,600	73.6	163	147	121
Delfos 651	1805	565	31.3	35.8	75.4	78.9	73,600	75.1	151	137	115
Deltapine 14	1560	596	38.2	35.1	75.1	73.9	72,000	78.8	149	139	119
Miller	1626	569	35.0	32.9	63.2	78.5	72,100	80.5	134	127	110
Stoneville 2B	1879	624	33.2	35.2	63.9	73.8	76,600	76.5	158	148	125
Wilds 15**	1393	415	29.8	40.0	67.8	74.7	85,000	76.0	140	124	88

*Coker 100-8 in 1944; Coker 100-9 in 1945.
**Wilds 16 in 1944; Wilds 17 in 1945.
***Based on 1944 test only.